Kawasaki

JET SKi® watercraft

ULTRA LX

# JET SKi® Watercraft Service Manual

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# Quick Reference Guide


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This quick reference guide will assist you in locating a desired topic or procedure.

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- Refer to the sectional table of contents for the exact pages to locate the specific topic required.

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The right is reserved to make changes at any time without prior notice and without incurring an obligation to make such changes to products manufactured previously. See your JET SKi® watercraft dealer for the latest information on product improvements incorporated after this publication.

All information contained in this publication is based on the latest product information available at the time of publication. Illustrations and photographs in this publication are intended for reference use only and may not depict actual model component parts.

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## LIST OF ABBREVIATIONS

| | | | |
|---|---|---|---|
| A | ampere(s) | KDS | Kawasaki Diagnostic System |
| ABDC | after bottom dead center | km/h | kilometers per hour |
| AC | alternating current | L | liter(s) |
| Ah | ampere hour | lb | pound(s) |
| ATDC | after top dead center | LCD | Liquid Crystal Display |
| BBDC | before bottom dead center | LED | Light Emission Diode |
| BDC | bottom dead center | m | meter(s) |
| BTDC | before top dead center | min | minute(s) |
| °C | degree(s) Celsius | mph | miles per hour |
| cmHg | centimeters of mercury | N | newton(s) |
| cu in | Cubic inch(s) | oz | ounce(s) |
| DC | direct current | Pa | pascal(s) |
| DFI | Digital Fuel Injection | PS | horsepower |
| ECU | Electronic Control Unit | psi | pound(s) per square inch |
| F | farad(s) | qt | quart(s) |
| °F | degree(s) Fahrenheit | r | revolution |
| FPO | Full Power Operation | rpm | revolution(s) per minute |
| ft | foot, feet | s | second(s) |
| g | gram(s) | SLO | Smart Learning Operation |
| gal | gallon(s) | TDC | top dead center |
| h | hour(s) | TIR | total indicator reading |
| HP | horsepower(s) | V | volt(s) |
| IC | Integrated Circuit | W | watt(s) |
| in. | inch(s) | Ω | ohm(s) |
| ISC | Idle Speed Control | | |

## COUNTRY AND AREA CODES

| | | | |
|---|---|---|---|
| AU | Australia | US | United States |
| EUR | Europe | | |

# MAINTENANCE AND ADJUSTMENTS

**Maintenance, replacement, or repair of the emission control devices and systems may be performed by any marine SI engine repair establishment or individual.**

# EMISSION CONTROL INFORMATION

**Fuel Information**

THIS ENGINE IS CERTIFIED TO OPERATE ON UNLEADED GRADE GASOLINE ONLY with an octane rating equal to or higher than that shown below.

| | |
|---|---|
| Minimum Octane Rating: | Antiknock Index* 87 |
| | Research Octane Number (RON) 91 |

*: The Antiknock Index is an average of the Research Octane Number (RON) and the Motor Octane Number (MON).

**Emission Control Information**

To protect the environment in which we all live, Kawasaki has incorporated an exhaust emission control system in compliance with applicable regulations of the United States Environmental Protection Agency and California Air Resources Board.

**Exhaust Emission Control System**

This system reduces the amount of pollutants discharged into the atmosphere by the exhaust of this engine. The fuel, ignition and exhaust systems of this engine have been carefully designed and constructed to ensure an efficient engine with low exhaust pollutant levels.

**Evaporative Emission Control System**

The evaporative emission control system for this watercraft consists of low permeation fuel hoses.

**Maintenance**

Proper maintenance and repair are necessary to ensure that watercraft will continue to have low emission levels. This Service Manual contains those maintenance and repair recommendations for this engine. Those items identified by the Periodic Maintenance Chart are necessary to ensure compliance with the applicable standards.

**Tampering with Emission Control System Prohibited**

Federal law prohibits the following acts or the causing thereof: (1) the removal or rendering inoperative by any person other than for purposes of maintenance, repair, or replacement, of any device or element of design incorporated into any new engine for the purposes of emission control prior to its sale or delivery to the ultimate purchaser or while it is in use, or (2) the use of the engine after such device or element of design has been removed or rendered inoperative by any person.

Among those acts presumed to constitute tampering are the acts listed below:

Do not tamper with the original emission related parts.

* Fuel Pump
* Spark Plugs
* Fuel Injectors
* ECU

# Foreword

This manual is designed primarily for use by trained mechanics in a properly equipped shop. However, it contains enough detail and basic information to make it useful to the owner who desires to perform his own basic maintenance and repair work. A basic knowledge of mechanics, the proper use of tools, and workshop procedures must be understood in order to carry out maintenance and repair satisfactorily. Whenever the owner has insufficient experience or doubts his ability to do the work, all adjustments, maintenance, and repair should be carried out only by qualified mechanics.

In order to perform the work efficiently and to avoid costly mistakes, read the text, thoroughly familiarize yourself with the procedures before starting work, and then do the work carefully in a clean area. Whenever special tools or equipment are specified, do not use makeshift tools or equipment. Precision measurements can only be made if the proper instruments are used, and the use of substitute tools may adversely affect safe operation.

**For the duration of the warranty period,** we recommend that all repairs and scheduled maintenance be performed in accordance with this service manual. Any owner maintenance or repair procedure not performed in accordance with this manual may void the warranty.

To get the longest life out of your JET SKi® watercraft:

- Follow the Periodic Maintenance Chart in the Service Manual.
- Be alert for problems and non-scheduled maintenance.
- Use proper tools and genuine Kawasaki JET SKi® watercraft parts. Special tools, gauges, and testers that are necessary when servicing Kawasaki JET SKi® watercraft are introduced by the Service Manual. Genuine parts provided as spare parts are listed in the Parts Catalog.
- Follow the procedures in this manual carefully. Don't take shortcuts.
- Remember to keep complete records of maintenance and repair with dates and any new parts installed.

## How to Use This Manual

In this manual, the product is divided into its major systems and these systems make up the manual's chapters. The Quick Reference Guide shows you all of the product's system and assists in locating their chapters. Each chapter in turn has its own comprehensive Table of Contents.

For example, if you want ignition coil information, use the Quick Reference Guide to locate the Electrical System chapter. Then, use the Table of Contents on the first page of the chapter to find the Ignition Coil section.

Whenever you see these WARNING and CAUTION symbols, heed their instructions! Always follow safe operating and maintenance practices.

**⚠ DANGER**

**DANGER indicates a hazardous situation which, if not avoided, will result in death or serious injury.**

**⚠ WARNING**

**WARNING indicates a hazardous situation which, if not avoided, could result in death or serious injury.**

***NOTICE***

**NOTICE is used to address practices not related to personal injury.**

This manual contains four more symbols (in addition to WARNING and CAUTION) which will help you distinguish different types of information.

**NOTE**

○ *This note symbol indicates points of particular interest for more efficient and convenient operation.*

● Indicates a procedural step or work to be done.

○ Indicates a procedural sub-step or how to do the work of the procedural step it follows. It also precedes the text of a NOTE.

★ Indicates a conditional step or what action to take based on the results of the test or inspection in the procedural step or sub-step it follows.

In most chapters an exploded view illustration of the system components follows the Table of Contents. In these illustrations you will find the instructions indicating which parts require specified tightening torque, oil, grease or a locking agent during assembly.

This model, JT1500K, is mounted with a four -stroke engine.

When the JET SKi® watercraft is submerged and swamped, the four-stroke engine needs special care and systematic procedure for recovery compared with the two-stroke engine. Therefore in this manual, such procedures, which are not shown in SMs for two-stroke engines, are explained thoroughly to cope with the cases.

Refer to the section, After submerging in Chapter 9, Cooling and Bilge Systems for the summary and detailed procedures.

# General Information

## Table of Contents

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## Before Servicing

Before starting to perform an inspection service or carry out a disassembly and reassembly operation on watercraft, read the precautions given below. To facilitate actual operations, notes, illustrations, photographs, cautions, and detailed descriptions have been included in each chapter wherever necessary. This section explains the items that require particular attention during the removal and reinstallation or disassembly and reassembly of general parts.

Especially note the following:

### *Kawasaki Diagnostic System (KDS) Software*

KDS software that runs on Windows personal computer (PC) will be available as a diagnostic tool for watercraft with Kawasaki DFI system.

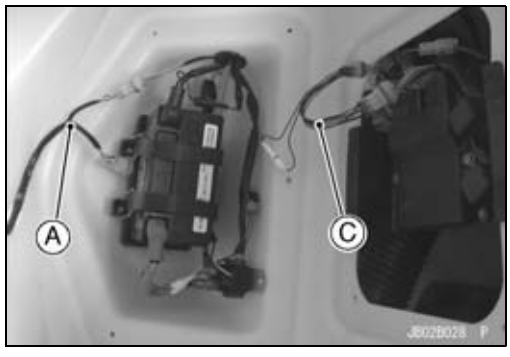
You need the following items to use the KDS.

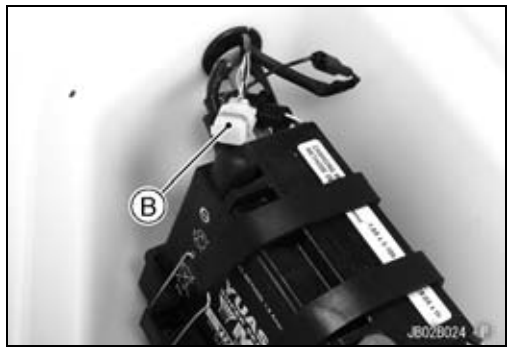
| Item | P/No. |
|---|---|
| KDS3 Kit | 57001-1747 |
| KDS Software (CD-ROM) | 57001-1650 |
| KDS3 Adapter | 57001-1725 |
| Communication Cable | 57001-1745 |
| KDS Adapter Cable | 57001-1696 |

The connectors for the communication cable and KDS adapter cable are located in the front storage compartment cover. Connect the communication cable [A] between the KDS connector (4-pin) [B] and KDS3 Adapter. Connect the KDS adapter cable [C] between the ignition switch (immobilizer amplifier) lead connectors (6-pin) [D].

**NOTE**

○*Connect the cable (57001-1696) to the ignition switch side connector first and then connect the ECU side connector.*




**A. Communication Cable (57001-1745)**
**B. KDS Adapter Cable (57001-1696)**

### *Adjustments*

Adjustments shall be made in accordance with the Periodic Maintenance Chart or whenever troubleshooting or presence of symptoms indicate that adjustments may be required. Whenever running of the engine is required during maintenance it is best to have the watercraft in water.

## Before Servicing

**NOTICE**

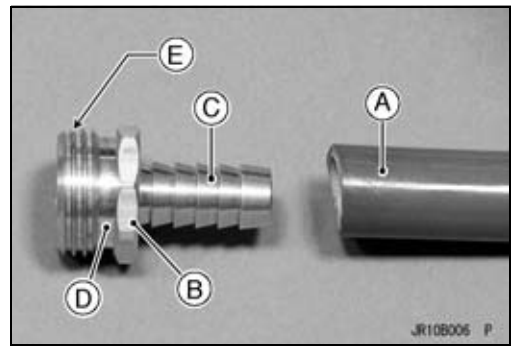
**Operating the engine without cooling water for more than 15 seconds, especially at high rpm, will cause severe engine and exhaust system damage. To avoid engine damage, do not run the engine without providing sufficient cooling water.**

### *Auxiliary Cooling*

An auxiliary cooling supply may be used if the watercraft cannot be operated in water during adjustments. If possible, always operate the watercraft in water rather than use an auxiliary cooling supply.

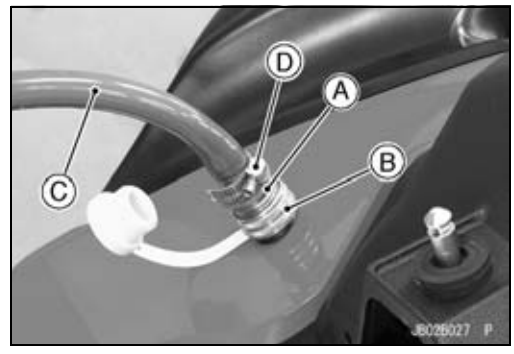
- Obtain a standard garden hose [A] and a garden hose adapter [B] as shown.
  C: Garden Hose Fitting of Adapter
  D: Flushing Fitting of Adapter
  E: Thread: Rp 3/4

○Optional part (P/No. 92005-3748) is available as a garden hose adapter.




- Open the front storage compartment cover.
- Remove the flushing cap [A] on the brim of the storage compartment.

- Screw a garden hose adapter [A] onto the flushing fitting [B].
- Attach a garden hose [C] to a garden hose adapter and secure the hose clamp [D].




- Attach the garden hose to a faucet. Do not turn on the water until the engine is running and turn it off immediately when the engine stops. The engine requires 2.4 L/min (2.5 qts/min) at 1 800 rpm and 7.0 L/min (7.4 qts/min) at 6 000 rpm.

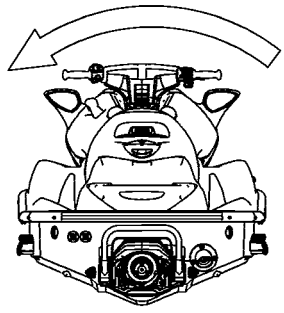
**NOTICE**

**Operating the engine without cooling water for more than 15 seconds, especially at high rpm, will cause severe engine and exhaust system damage. To avoid engine damage, do not run the engine without providing sufficient cooling water.**
**An excessive supply of cooling water may cause the engine to stop and flood the cylinders, creating the potential for hydraulic lock which causes severe engine damage. To prevent engine damage when using an auxiliary cooling supply, shut the water off immediately if the engine stops running.**

## Before Servicing

**NOTICE**

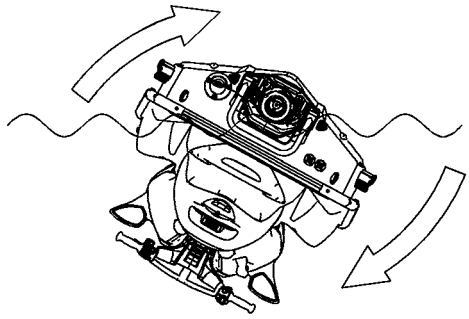
**Rolling to the right side can cause water in the exhaust system to run into the engine, with possible engine damage. To prevent engine damage, always turn the boat on its left side.**



JB02024BWI C

**NOTICE**

**Rolling the capsized watercraft counterclockwise (to its STARBOARD side) can cause water in the exhaust system to run into the engine, with possible engine damage. Always turn the capsized boat clockwise so that the PORT side always faces downward.**



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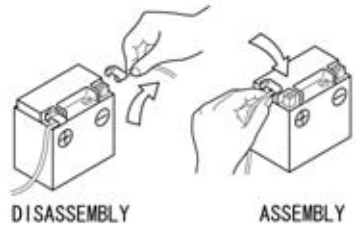
### *Battery Ground*

Before completing any service on the watercraft, disconnect the battery wires from the battery to prevent the engine from accidentally turning over. Disconnect the ground wire (–) first and then the positive (+). When completed with the service, first connect the positive (+) wire to the positive (+) terminal of the battery then the negative (–) wire to the negative terminal.

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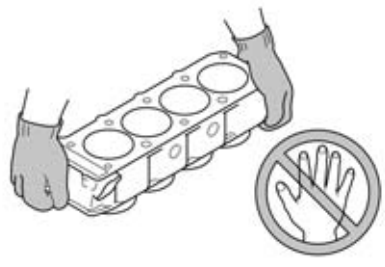
### *Edges of Parts*

Lift large or heavy parts wearing gloves to prevent injury from possible sharp edges on the parts.



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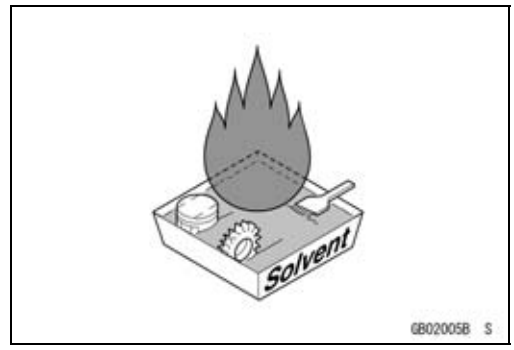
## Before Servicing

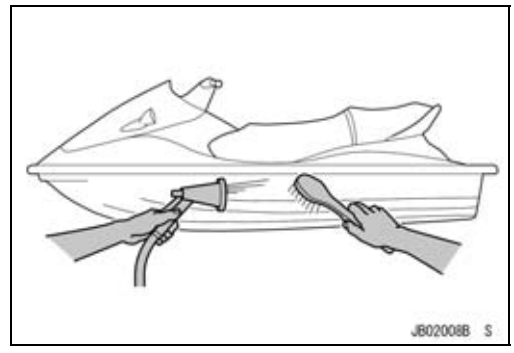
### *Solvent*

Use a high-flash point solvent when cleaning parts. High -flash point solvent should be used according to directions of the solvent manufacturer.



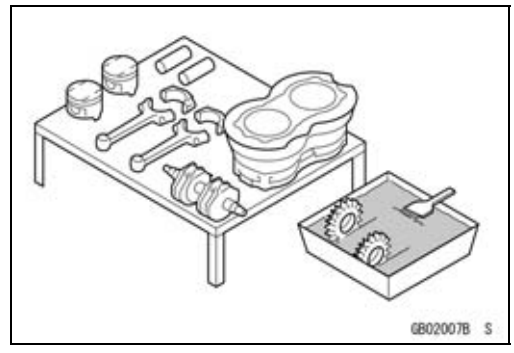

### *Cleaning Watercraft before Disassembly*

Clean the watercraft thoroughly before disassembly. Dirt or other foreign materials entering into sealed areas during watercraft disassembly can cause excessive wear and decrease performance of the watercraft.



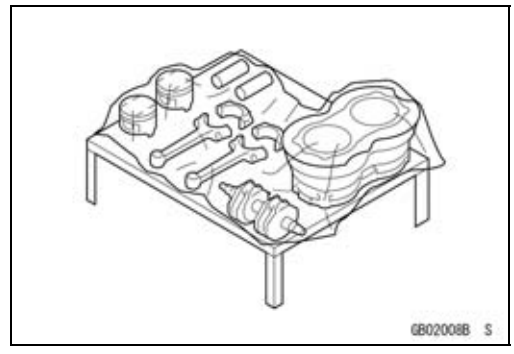

### *Arrangement and Cleaning of Removed Parts*

Disassembled parts are easy to confuse. Arrange the parts according to the order the parts were disassembled and clean the parts in order prior to assembly.



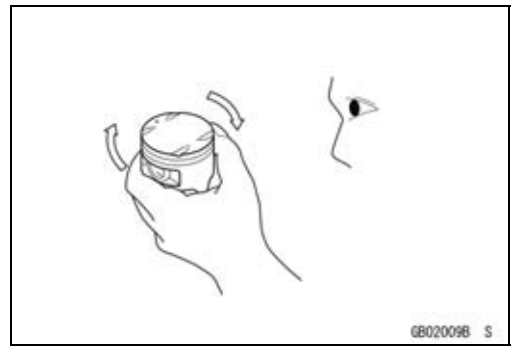

### *Storage of Removed Parts*

After all the parts including subassembly parts have been cleaned, store the parts in a clean area. Put a clean cloth or plastic sheet over the parts to protect from any foreign materials that may collect before re-assembly.




### *Inspection*

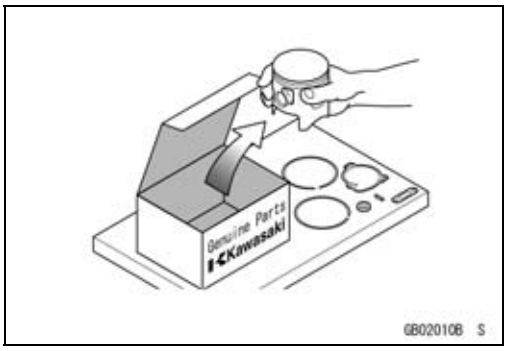
Reuse of worn or damaged parts may lead to serious accident. Visually inspect removed parts for corrosion, discoloration, or other damage. Refer to the appropriate sections of this manual for service limits on individual parts. Replace the parts if any damage has been found or if the part is beyond its service limit.



## Before Servicing

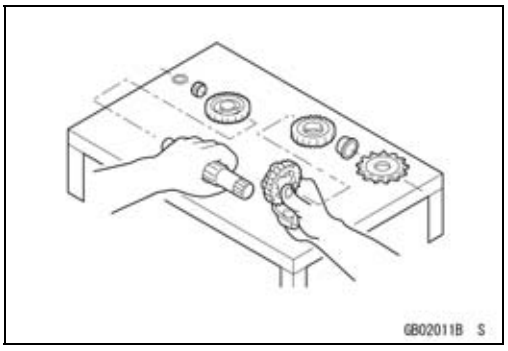
### *Replacement Parts*

Replacement parts must be KAWASAKI genuine or recommended by KAWASAKI. Gaskets, O-rings, oil seals, grease seals, circlips, cotter pins or self-locking nuts must be replaced with new ones whenever disassembled.



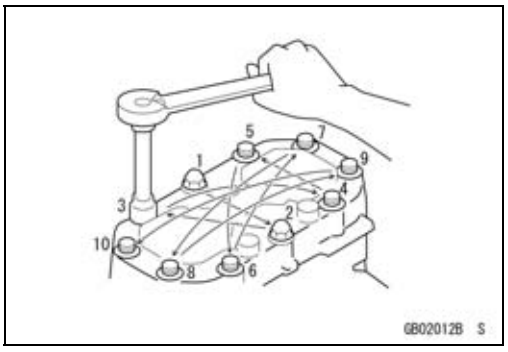

### *Assembly Order*

In most cases assembly order is the reverse of disassembly, however, if assembly order is provided in this Service Manual, follow the procedures given.



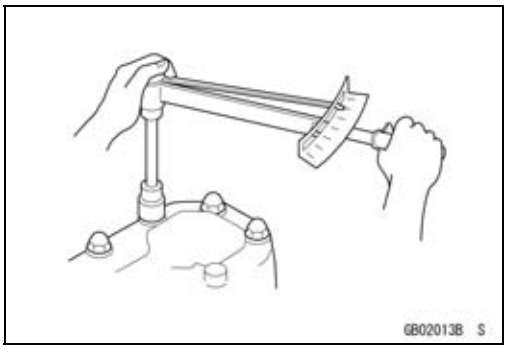

### *Tightening Sequence*

Generally, when installing a part with several bolts, nuts, or screws, start them all in their holes and tighten them to a snug fit. Then tighten them according to the specified sequence to prevent case warpage or deformation which can lead to malfunction. Conversely when loosening the bolts, nuts, or screws, first loosen all of them by about a quarter turn and then remove them. If the specified tightening sequence is not indicated, tighten the fasteners alternating diagonally.



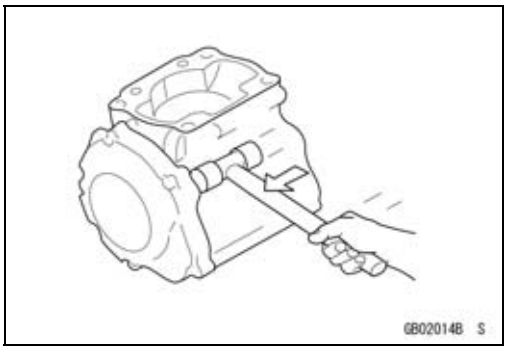

### *Tightening Torque*

Incorrect torque applied to a bolt, nut, or screw may lead to serious damage. Tighten fasteners to the specified torque using a good quality torque wrench.




### *Force*

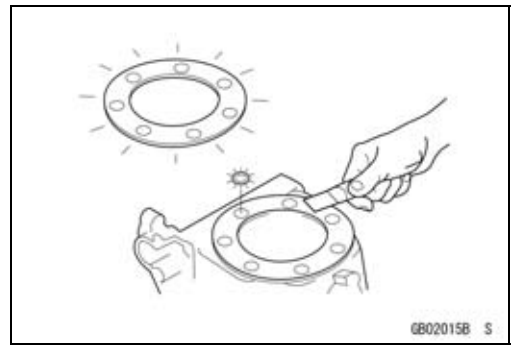
Use common sense during disassembly and assembly, excessive force can cause expensive or hard to repair damage. When necessary, remove screws that have a non-permanent locking agent applied using an impact driver. Use a plastic-faced mallet whenever tapping is necessary.



## Before Servicing

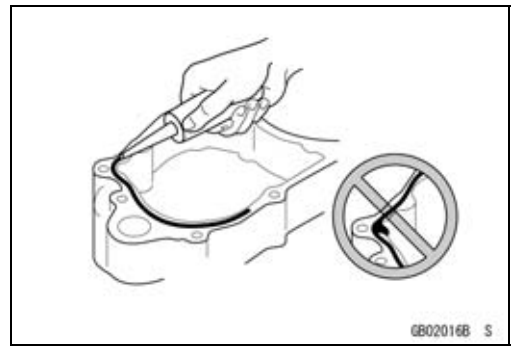
### *Gasket, O-ring*

Hardening, shrinkage, or damage of both gaskets and O-rings after disassembly can reduce sealing performance. Remove old gaskets and clean the sealing surfaces thoroughly so that no gasket material or other material remains. Install new gaskets and replace used O-rings when re-assembling



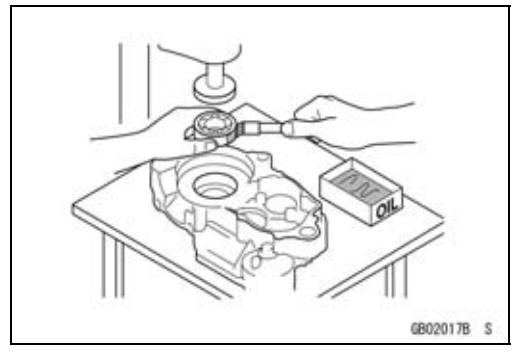

### *Liquid Gasket, Locking Agent*

For applications that require Liquid Gasket or a Locking agent, clean the surfaces so that no oil residue remains before applying liquid gasket or locking agent. Do not apply them excessively. Excessive application can clog oil passages and cause serious damage.




### *Press*

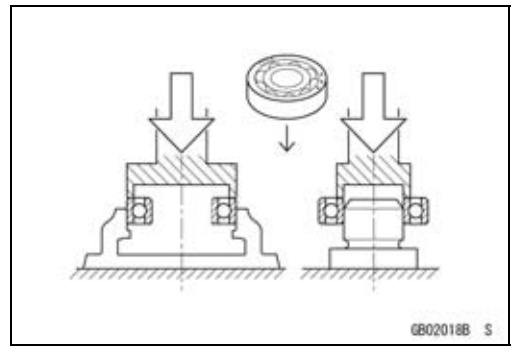
For items such as bearings or oil seals that must be pressed into place, apply small amount of oil to the contact area. Be sure to maintain proper alignment and use smooth movements when installing.




### *Ball Bearing*

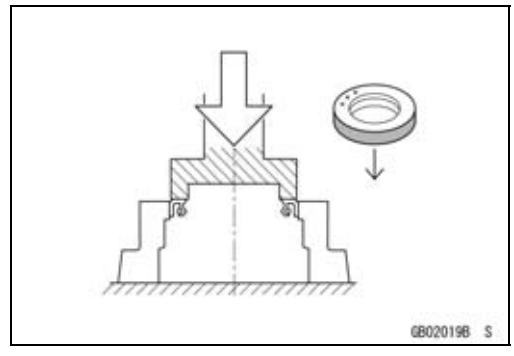
Do not remove pressed ball or needle unless removal is absolutely necessary. Replace with new ones whenever removed. Press bearings with the manufacturer and size marks facing out. Press the bearing into place by putting pressure on the correct bearing race as shown.

Pressing the incorrect race can cause pressure between the inner and outer race and result in bearing damage.

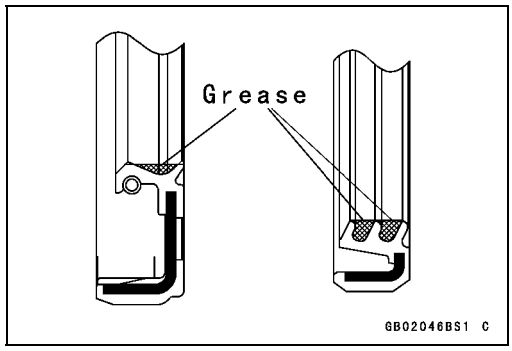



### *Oil Seal, Grease Seal*

Do not remove pressed oil or grease seals unless removal is necessary. Replace with new ones whenever removed. Press new oil seals with manufacture and size marks facing out. Make sure the seal is aligned properly when installing.

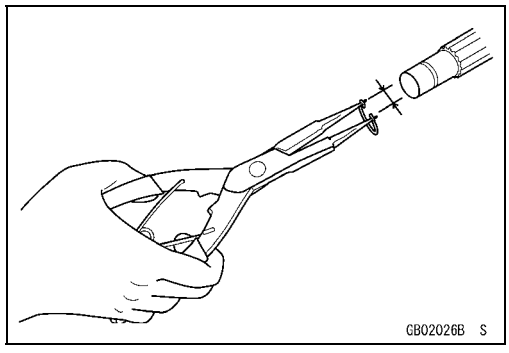


Apply specified grease to the lip of seal before installing the seal.



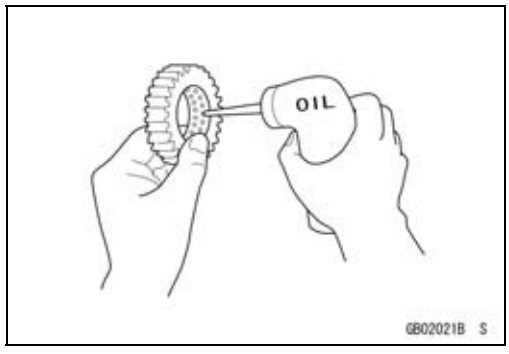

### *Circlips, Cotter Pins*

Replace circlips or cotter pins that were removed with new ones. Take care not to open the clip excessively when installing to prevent deformation.



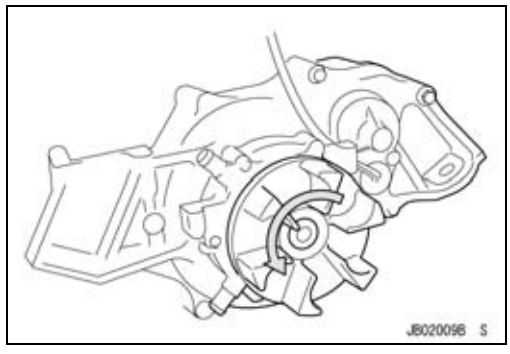

### *Lubrication*

It is important to lubricate rotating or sliding parts during assembly to minimize wear during initial operation. Lubrication points are called out throughout this manual, apply the specific oil or grease as specified.



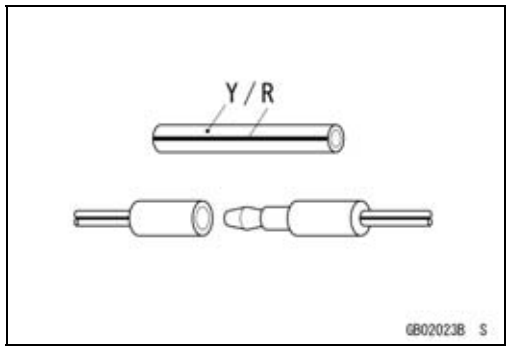

### *Direction of Engine Rotation*

When rotating the crankshaft, by hand, the free play amount of rotating direction will affect the adjustment. Rotate the crankshaft to positive direction (counter-clockwise viewed from stern side).




### *Electrical Wires*

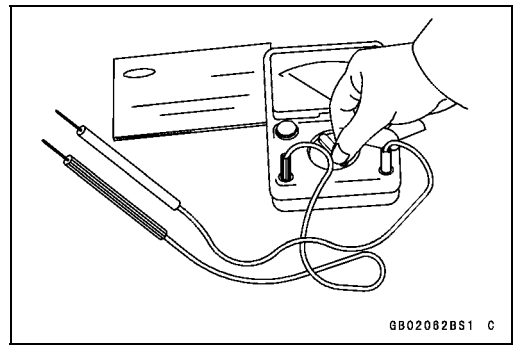
A two-color wire is identified first by the primary color and then the stripe color. Unless instructed otherwise, electrical wires must be connected to those of the same color.



## Before Servicing

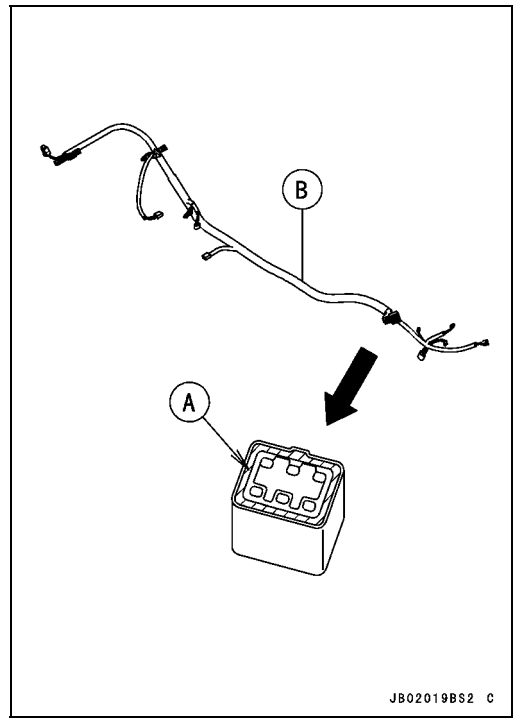
### *Instrument*

Use a meter that has enough accuracy for an accurate measurement. Read the manufacture's instructions thoroughly before using the meter. Incorrect values may lead to improper adjustments.




### *Harness Connector*

Apply dielectric grease [A] on all connectors of harness [B] for water resistance. Do not apply grease on the only connector of inlet air pressure sensor.



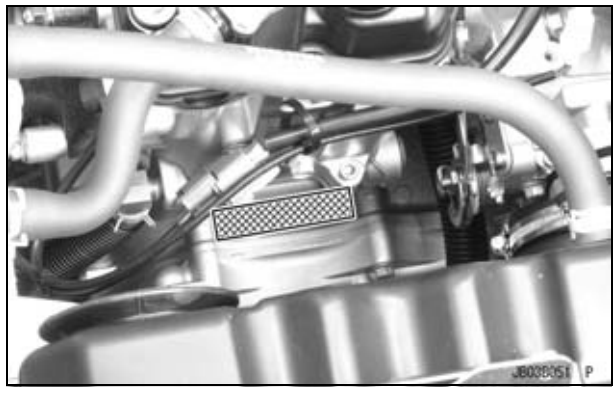
## Model Identification

**JT1500KC Left Side View**

**JT1500KC Right Side View**

**Hull Identification Number (HIN)**

**Engine Number**



## General Specifications

| Items | JT1500KC |
|---|---|
| **Engine** | |
| Type | 4-stroke, DOHC, 4-cylinder, water cooled |
| Displacement | 1 498 cm³ (91.4 cu in.) |
| Bore and Stroke | 83 × 69.2 mm (3.27 × 2.72 in.) |
| Compression Ratio | 10.6:1 |
| Maximum Horsepower | 112 kW (152 PS) @7 500 r/min (rpm)<br>(AU) 118 kW (160 PS) @7 500 r/min (rpm)<br>(US) – – – |
| Maximum Torque | 144 N·m (14.7 kgf·m, 106 ft·lb) @7 250 r/min (rpm)<br>(AU) 152 N·m (15.5 kgf·m, 112 ft·lb) @7 250 r/min (rpm)<br>(US) – – – |
| Ignition System | Digital transistor |
| Lubrication System | Forced lubrication (semi-dry sump) |
| Carburetion System | FI (fuel injection) MIKUNI AC 60 × 1 |
| Starting System | Electric starter |
| Cylinder Numbering Method | Front (bow) to rear (stern), 1-2-3-4 |
| Firing Order | 1-2-4-3 |
| Valve Timing: | |
| Intake: | |
| Open | 22.5° BTDC |
| Close | 67.5° ABDC |
| Duration | 270° |
| Exhaust: | |
| Open | 74.5° BBDC |
| Close | 9.5° ATDC |
| Duration | 264° |
| **Tuning Specifications** | |
| Spark plug: | |
| Type | NGK CR9EK |
| Terminal | Threaded terminal |
| Gap | 0.7 ~ 0.8 mm (0.028 ~ 0.031 in.) |
| Ignition Timing | 3° ATDC @1 300 r/min ~ 32° BTDC @3 000 r/min (rpm) |
| Idle Speed | 1 300 ±100 r/min (rpm) -in water<br>1 300 ±100 r/min (rpm) -out of water |
| Compression Pressure | 1 190 ~ 1 799 kPa (12.1 ~ 18.3 kgf/cm², 173 ~ 261 psi) @430 r/min (rpm) |
| **Drive System** | |
| Coupling | Direct drive from engine |
| Jet Pump: | |
| Type | Axial flow single stage |
| Thrust: | |
| EUR Model | 4 130 N (421.3 kgf, 928.4 lb) |
| Other than EUR Models | 4 250 N (433.5 kgf, 955.4 lb) |
| Steering | Steerable nozzle |
| Braking | Water drag |

## General Specifications

| Items | JT1500KC |
|---|---|
| **Performance** | |
| †Minimum Turning Radius | 4.0 m (13.1 ft) |
| †Fuel Consumption | 45 L/h (11.9 US gal/h) @full throttle |
| †Cruising Range | 133 km (82.6 mile) @full throttle 1 hour and 38 minutes (3 person) |
| **Dimensions** | |
| Overall Length | 3 370 mm (132.7 in.) |
| Overall Width | 1 195 mm (47.0 in.) |
| Overall Height | 1 150 mm (45.3 in.) |
| Curb Mass | 423 kg (932.7 lb) |
| Fuel Tank Capacity | 78 L (20.6 US gal) |
| **Engine Oil** | |
| Grade | API SG, SH, SJ, SL or SM with JASO MA, MA1 or MA2 |
| Viscosity | SAE 10W-40 |
| Capacity | 5.0 L (5.3 US qt) |
| **Electrical Equipment** | |
| Battery | 12 V 18 Ah |
| Maximum Generator Output | 16 A @14 V |

†: This information shown here represents results under controlled conditions, and the information may not be correct under other conditions.

Specifications subject to change without notice, and may not apply to every country.

## Unit Conversion Table

### Prefixes for Units

| Prefix | Symbol | Power |
|---|---|---|
| mega | M | × 1 000 000 |
| kilo | k | × 1 000 |
| centi | c | × 0.01 |
| milli | m | × 0.001 |
| micro | μ | × 0.000001 |

### Units of Mass

| | | | | |
|---|---|---|---|---|
| kg | × | 2.205 | = | lb |
| g | × | 0.03527 | = | oz |

### Units of Volume

| | | | | |
|---|---|---|---|---|
| L | × | 0.2642 | = | gal (US) |
| L | × | 0.2200 | = | gal (IMP) |
| L | × | 1.057 | = | qt (US) |
| L | × | 0.8799 | = | qt (IMP) |
| L | × | 2.113 | = | pint (US) |
| L | × | 1.816 | = | pint (IMP) |
| mL | × | 0.03381 | = | oz (US) |
| mL | × | 0.02816 | = | oz (IMP) |
| mL | × | 0.06102 | = | cu in |

### Units of Force

| | | | | |
|---|---|---|---|---|
| N | × | 0.1020 | = | kg |
| N | × | 0.2248 | = | lb |
| kg | × | 9.807 | = | N |
| kg | × | 2.205 | = | lb |

### Units of Length

| | | | | |
|---|---|---|---|---|
| km | × | 0.6214 | = | mile |
| m | × | 3.281 | = | ft |
| mm | × | 0.03937 | = | in. |

### Units of Torque

| | | | | |
|---|---|---|---|---|
| N·m | × | 0.1020 | = | kgf·m |
| N·m | × | 0.7376 | = | ft·lb |
| N·m | × | 8.851 | = | in·lb |
| kgf·m | × | 9.807 | = | N·m |
| kgf·m | × | 7.233 | = | ft·lb |
| kgf·m | × | 86.80 | = | in·lb |

### Units of Pressure

| | | | | |
|---|---|---|---|---|
| kPa | × | 0.01020 | = | kgf/cm² |
| kPa | × | 0.1450 | = | psi |
| kPa | × | 0.7501 | = | cmHg |
| kgf/cm² | × | 98.07 | = | kPa |
| kgf/cm² | × | 14.22 | = | psi |
| cmHg | × | 1.333 | = | kPa |

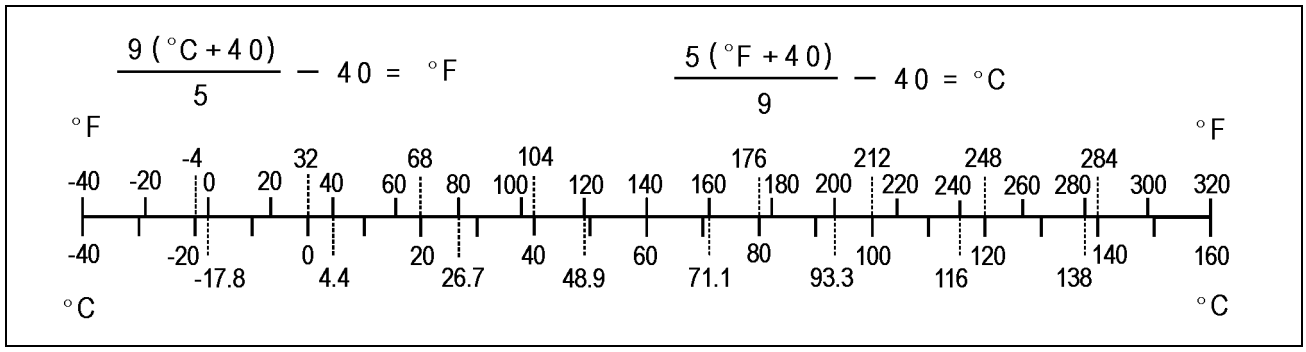
### Units of Speed

| | | | | |
|---|---|---|---|---|
| km/h | × | 0.6214 | = | mph |

### Units of Power

| | | | | |
|---|---|---|---|---|
| kW | × | 1.360 | = | PS |
| kW | × | 1.341 | = | HP |
| PS | × | 0.7355 | = | kW |
| PS | × | 0.9863 | = | HP |

### Units of Temperature



# Periodic Maintenance

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# 2-2 PERIODIC MAINTENANCE

## Periodic Maintenance Chart

The scheduled maintenance must be done in accordance with this chart to keep the watercraft in good running condition. **The initial maintenance is vitally important and must not be neglected.**

| Frequency / Description | Initial 10 Hours | Every 25 Hours | Every 50 Hours | Every 100 Hours | Reference |
|---|---|---|---|---|---|
| Inspect throttle control system (e) | | ● | | | 2-10 |
| Inspect/clean air box drain caps | | ● | | | 2-11 |
| Inspect fuel vent check valve | | ● | | | 2-11 |
| Clean fuel pump screen (e) | | ● | | | 2-12 |
| Inspect throttle shaft spring (replace throttle body if necessary) (e) | | | | ● | 2-12 |
| Replace engine oil | | ● (or every year) | | | 2-13 |
| Replace engine oil filter | | | | ● | 2-14 |
| Inspect/adjust valve clearance (e) | | | | ● | 2-15 |
| Inspect/tighten engine mounting bolts | | | ● (or every year) | | 2-18 |
| Inspect/replace coupling damper | | | | ● | 2-19 |
| Flush cooling system (after each use in salt water) | | ● | | | 2-19 |
| Flush bilge line and filter | | ● | | | 2-20 |
| Inspect impeller blades for damage (remove) | | | | ● | 2-21 |
| Jet pump bearings and seals; replace bearings/seals if necessary | Initial 25 hours or one year whichever comes first, then every 50 hours or every year whichever comes first | | | | 2-21 |
| Inspect steering cable/shift cable | | | | ● | 2-21 |
| Lubricate handlebar pivot (disassemble) | | ● | | | 2-22 |
| Inspect hull drain plugs (replace if necessary) | | | ● | | 2-22 |
| Inspect battery charging condition | | ● | | | 2-23 |
| Inspect battery terminals | | ● | | | 2-23 |
| Inspect spark plugs (replace if necessary) (e) | | ● | | | 2-23 |
| Lubricate throttle cable fitting at throttle body | | ● | | | 2-24 |
| Lubricate throttle cable and throttle fitting at throttle case | | ● | | | 2-24 |
| Lubricate steering cable/shift cable ball joints and steering nozzle/reverse bucket pivots | | ● | | | 2-24 |
| Inspect all hoses, hose clamps, nuts, bolts, and fasteners | ● | ● | | | 2-27 |
| Replace fuel hose | Every 5 years | | | | 2-29 |

(e): Emission Related Items

## Torque and Locking Agent

The following tables list the tightening torque for the major fasteners requiring use of a non-permanent locking agent or silicone sealant etc.

Letters used in the “Remarks” column mean:
AD: Apply adhesive.
EO: Apply engine oil.
G: Apply grease.
L: Apply a non-permanent locking agent (Medium Strength: Loctite 242 Equivalent).
LN: Apply a non-permanent locking agent (High Strength: Loctite 271 Equivalent).
MO: Apply molybdenum disulfide oil solution.
(mixture of the engine oil and molybdenum disulfide grease in a weight ratio 10:1)
R: Replacement Part
S: Follow the specified tightening sequence.
SS: Apply silicone sealant.

| Fastener | Torque | | | Remarks |
|---|---|---|---|---|
| | N·m | kgf·m | ft·lb | |
| **Fuel System (DFI)** | | | | |
| Air Box Mounting Bolts | 7.8 | 0.80 | 69 in·lb | L |
| Air Box Bracket Mounting Bolts | 8.8 | 0.90 | 78 in·lb | L |
| Air Box Flame Arrester Bolts | 2.5 | 0.25 | 22 in·lb | |
| Air Box Assembly Bolts | 2.5 | 0.25 | 22 in·lb | L (1) |
| Bracket Bolts | 8.8 | 0.90 | 78 in·lb | L |
| Camshaft Position Sensor Bolt | 10 | 1.0 | 89 in·lb | L |
| Crankshaft Sensor Screws | 4.5 | 0.46 | 40 in·lb | L |
| Delivery Pipe Assy Mounting Bolts | 7.8 | 0.80 | 69 in·lb | |
| Delivery Pipe Fitting | 20 | 2.0 | 15 | L |
| Delivery Pipe Plug | 11 | 1.1 | 97 in·lb | L |
| ECU Mounting Bolts | 3.0 | 0.31 | 27 in·lb | L |
| Fuel Filler Hose Clamp Screws | 2.9 | 0.30 | 26 in·lb | |
| Fuel Pump Rubber Holder Clamp Screws | 2.9 | 0.30 | 26 in·lb | |
| Intake Air Temperature Sensor | 20 | 2.0 | 15 | |
| Intake Manifold Drain Plug | 20 | 2.0 | 15 | |
| Intake Manifold Plate Bolts | 7.8 | 0.80 | 69 in·lb | |
| Intake Air Pressure Sensor Bolts | 7.8 | 0.80 | 69 in·lb | |
| ISC Actuator Mounting Bolts | 5.0 | 0.51 | 44 in·lb | |
| Intake Manifold Mounting Bolts | 25 | 2.5 | 18 | L |
| Intake Manifold Mounting Nuts | 20 | 2.0 | 15 | |
| Oil Temperature Sensor | 15 | 1.5 | 11 | |
| Relay Mounting Bolts | 2.5 | 0.25 | 22 in·lb | L |
| Throttle Position Sensor Mounting Screws | 20 | 2.0 | 18 in·lb | |
| Stepping Motor Mounting Screws | 2.0 | 0.20 | 18 in·lb | |
| Throttle Body Assy Mounting Bolts | 2.0 | 0.20 | 15 in·lb | |
| Throttle Cable Locknut | 19.6 | 2.0 | 14 | |
| Throttle Case Mounting Screw | 3.9 | 0.40 | 35 in·lb | |
| Vehicle-down Sensor Mounting Screws | 1.5 | 0.15 | 13 in·lb | |
| Water Temperature Sensor | 14.7 | 1.5 | 11 | |

## Torque and Locking Agent

| Fastener | Torque | | | Remarks |
|---|---|---|---|---|
| | N·m | kgf·m | ft·lb | |
| **Engine Lubrication System** | | | | |
| Breather Plate Bolts | 7.8 | 0.80 | 69 in·lb | |
| Dipstick Tube Bolts | 8.8 | 0.90 | 78 in·lb | L, S |
| Oil Catch Cover Bolts | 7.8 | 0.80 | 69 in·lb | |
| Oil Cooler Assembly Bolts | 7.8 | 0.80 | 69 in·lb | |
| Oil Cooler Positioning Bolt | 20 | 2.0 | 15 | S |
| Oil Filler Cap | – | – | – | Hand -tighten |
| Oil Filter | 18 | 1.8 | 13 | EO, R |
| Oil Pan Bolts | 20 | 2.0 | 15 | S |
| Oil Passage Bolt | 78 | 8.0 | 58 | S |
| Oil Passage Joints | 11 | 1.1 | 97 in·lb | L |
| Oil Passage Plug (R1/4) | 7.8 | 0.80 | 69 in·lb | L |
| Oil Passage Plug (R3/8) | 20 | 2.0 | 15 | L |
| Oil Pressure Relief Valve | 15 | 1.5 | 11 | LN |
| Oil Pressure Switch | 15 | 1.5 | 11 | L |
| Oil Pump Body Bolts | 7.8 | 0.80 | 69 in·lb | |
| Oil Pump Body Plug | 20 | 2.0 | 15 | L |
| Oil Pump Cover Bolts | 7.8 | 0.80 | 69 in·lb | |
| Oil Pump Sprocket Bolt | 16 | 1.6 | 12 | LN |
| Oil Screen Bolts | 7.8 | 0.80 | 69 in·lb | |
| Oil Separator Tank Mounting Nuts | 4.9 | 0.50 | 43 in·lb | L |
| **Exhaust System** | | | | |
| Exhaust Manifold Mounting Bolts | 25 | 2.5 | 18 | L, S |
| Exhaust Manifold Mounting Nuts | 25 | 2.5 | 18 | S |
| Exhaust Pipe Mounting Bolts | 45 | 4.6 | 33 | |
| Exhaust Pipe Mounting Plate Bolts | 30 | 3.1 | 22 | L |
| Front Exhaust Hose Clamp Screws | 5.0 | 0.51 | 44 in·lb | |
| Rear Exhaust Hose Clamp Screws | 5.0 | 0.51 | 44 in·lb | |
| Water Hose Joints | 11 | 1.1 | 97 in·lb | L |
| **Engine Top End** | | | | |
| Camshaft Cap Bolts (L = 40 mm) | 12 | 1.2 | 106 in·lb | S |
| Camshaft Cap Bolts (L = 50 mm) | 12 | 1.2 | 106 in·lb | S |
| Camshaft Chain Tensioner Cap Bolt | 20 | 2.0 | 15 | |
| Camshaft Chain Tensioner Mounting Bolts | 10 | 1.0 | 89 in·lb | L |
| Camshaft Position Sensor Rotor Bolt | 12 | 1.2 | 106 in·lb | LN |
| Cylinder Head Bolts (M11, Final) | 60 | 6.1 | 44 | MO, S |
| Cylinder Head Bolts (M11, First) | 23 | 2.3 | 17 | MO, S |
| Cylinder Head Bolts (M6) | 12 | 1.2 | 106 in·lb | S |
| Cylinder Head Bolts (M7) | 20 | 2.0 | 15 | S |
| Cylinder Head Cover Bolts | 10 | 1.0 | 89 in·lb | |
| Breather Plate Bolts | 7.8 | 0.80 | 69 in·lb | |
| Engine Hook Bolts | 20 | 2.0 | 15 | |

## Torque and Locking Agent

| Fastener | Torque | | | Remarks |
|---|---|---|---|---|
| | N·m | kgf·m | ft·lb | |
| Exhaust Side Camshaft Chain Guide Bolt (Lower) | 12 | 1.2 | 106 in·lb | |
| Exhaust Side Camshaft Chain Guide Bolt (Upper) | 25 | 2.5 | 18 | |
| Harness Clamp Mounting Bolts | 8.8 | 0.90 | 78 in·lb | L |
| Intake Side Camshaft Chain Guide Bolt | 12 | 1.2 | 106 in·lb | L |
| Oil Passage Joints | 11 | 1.1 | 97 in·lb | L |
| Spark Plugs | 13 | 1.3 | 115 in·lb | |
| Upper Camshaft Chain Guide Bolts | 12 | 1.2 | 106 in·lb | S |
| Water Hose Joint | 11 | 1.1 | 97 in·lb | L |
| Water Jacket Plugs | 19.6 | 2.0 | 14 | L |
| **Engine Removal/Installation** | | | | |
| Engine Damper Mounting Bolts | 15.7 | 1.6 | 12 | L |
| Engine Mounting Bolts | 36.3 | 3.7 | 27 | L |
| **Engine Bottom End** | | | | |
| Alternator Cover Bolts (L = 40 mm) | 20 | 2.0 | 15 | |
| Alternator Cover Bolts (L = 60 mm) | 20 | 2.0 | 15 | |
| Connecting Rod Nuts | see text | ← | ← | MO, R |
| Coupling | 110 | 11.2 | 81 | |
| Coupling Cover Bolts | 8.8 | 0.90 | 78 in·lb | L |
| Crankcase Bolts (M6) | 12 | 1.2 | 106 in·lb | S |
| Crankcase Bolts (M8, L = 45 mm) | 30 | 3.1 | 22 | S |
| Crankcase Bolt (M8, L = 55 mm) | 30 | 3.1 | 22 | S |
| Crankcase Bolts (M8, L = 85 mm) | 30 | 3.1 | 22 | MO, S |
| Crankcase Bolts (M10) | 50 | 5.1 | 37 | MO, S |
| Engine Bracket Mounting Bolts | 32 | 3.3 | 24 | L |
| Oil Passage Plug (R1/4) | 7.8 | 0.80 | 69 in·lb | L |
| Oil Passage Plugs (R3/8) | 20 | 2.0 | 15 | L |
| Output Cover Bolts | 7.8 | 0.80 | 69 in·lb | |
| Output Shaft | 265 | 27.0 | 195 | MO |
| Oil Catch Cover Bolts | 7.8 | 0.80 | 69 in·lb | |
| Stator Coil Grommet Holder Plate Bolts | 8.8 | 0.90 | 78 in·lb | L |
| Stator Coil Mounting Bolts | 12 | 1.2 | 106 in·lb | L |
| **Cooling and Bilge Systems** | | | | |
| Flushing Cap | 0.90 | 0.092 | 8.0 in·lb | |
| Water Pipe Mounting Bolts | 7.8 | 0.80 | 69 in·lb | |
| Water Hose Clamp Screws | 2.5 | 0.25 | 22 in·lb | |
| Water Hose Clamp Screw | 3.0 | 0.31 | 27 in·lb | |
| Water Hose Clamp Screws | 4.0 | 0.41 | 35 in·lb | |
| Water Hose Joints | 11 | 1.1 | 97 in·lb | L |
| Water Hose Joint (Water Pipe) | 20 | 2.0 | 15 | L |
| **Drive System** | | | | |
| Coupling | 265 | 27.0 | 195 | |
| Drive Shaft Holder Mounting Bolts | 22 | 2.2 | 16 | L |

## Torque and Locking Agent

| Fastener | Torque | | | Remarks |
|---|---|---|---|---|
| | N·m | kgf·m | ft·lb | |
| **Pump and Impeller** | | | | |
| Filter Cover Mounting Bolts | 9.8 | 1.0 | 87 in·lb | L |
| Grate Mounting Bolts | 9.8 | 1.0 | 87 in·lb | L |
| Impeller | 147 | 15.0 | 108 | M |
| Pump Bracket Mounting Bolts (M6) | 9.8 | 1.0 | 87 in·lb | L |
| Pump Bracket Mounting Bolts (M8) | 19 | 1.9 | 14 | LN, SS |
| Pump Cap Bolts | 3.9 | 0.40 | 35 in·lb | L |
| Pump Cover Mounting Bolts | 7.8 | 0.80 | 69 in·lb | L |
| Pump Mounting Bolts | 36 | 3.7 | 27 | L |
| Pump Outlet Mounting Bolts | 19 | 1.9 | 14 | L |
| Pump Shaft Nut | 98 | 10 | 72 | |
| Steering Cable Joint Bolt | 9.8 | 1.0 | 87 in·lb | L |
| Steering Nozzle Pivot Bolts | 19 | 1.9 | 14 | L |
| **Steering** | | | | |
| Adjustable Steering Holder Nut | 4.9 | 0.50 | 43 in·lb | |
| Handlebar Clamp Bolts | 15.7 | 1.6 | 12 | L, S |
| Reverse Bucket Pivot Bolts | 19 | 1.9 | 14 | LN |
| Start/Stop Switch Case Mounting Screws | 3.9 | 0.40 | 35 in·lb | |
| Shift Cable End Nut | 9.8 | 1.0 | 87 in·lb | |
| Shift Cable Nut | 39.2 | 4.0 | 29 | |
| Steering Cable Bracket Bolts | 9.8 | 1.0 | 87 in·lb | L |
| Steering Cable Joint Bolt | 9.8 | 1.0 | 87 in·lb | L |
| Steering Cable Nut | 39.2 | 4.0 | 29 | |
| Steering Holder Mounting Nuts | 19.6 | 2.0 | 14 | |
| Steering Neck Mounting Bolts | 15.7 | 1.6 | 12 | L |
| Steering Shaft Locknut | 29.4 ~ 34.3 | 3.0 ~ 3.5 | 22 ~ 25 | |
| Steering Shaft Nut | 2.9 | 0.30 | 26 in·lb | |
| Throttle Case Mounting Screws | 3.9 | 0.40 | 35 in·lb | |
| **Hull/Engine Hood** | | | | |
| Bracket Bolts | 8.8 | 0.90 | 78 in·lb | L |
| Front Hatch Mounting Screws | 2.0 | 0.20 | 18 in·lb | AD |
| Handrail Mounting Screws | 4.0 | 0.41 | 35 in·lb | |
| Handrail Plate Nuts | 9.8 | 1.0 | 87 in·lb | L |
| Latch Handle Screws | 2.0 | 0.20 | 18 in·lb | |
| Seat Lock Ratchet Pins | 27 | 2.8 | 20 | L |
| Stabilizer Bolts | 15.7 | 1.6 | 12 | LN |
| **Electrical System** | | | | |
| Bracket Bolts | 8.8 | 0.90 | 78 in·lb | L |
| Camshaft Position Sensor Bolt | 10 | 1.0 | 89 in·lb | L |
| Crankshaft Sensor Cover Bolts | 7.8 | 0.80 | 69 in·lb | |
| Crankshaft Sensor Screws | 4.5 | 0.46 | 40 in·lb | L |
| ECU Mounting Bolts | 3.0 | 0.31 | 27 in·lb | L |
| Ignition Coil Mounting Bolts | 8.8 | 0.90 | 78 in·lb | L |

## Torque and Locking Agent

| Fastener | Torque | | | Remarks |
|---|---|---|---|---|
| | N·m | kgf·m | ft·lb | |
| Meter Unit Mounting Bolts | 9.8 | 1.0 | 87 in·lb | L |
| Oil Temperature Sensor | 15 | 1.5 | 11 | |
| Regulator/Rectifier Bolts | 7.8 | 0.80 | 69 in·lb | |
| Relay Mounting Bolts | 2.5 | 0.25 | 22 in·lb | L |
| Rubber Grommet Holder Screws | 4.5 | 0.46 | 40 in·lb | L |
| Spark Plugs | 13 | 1.3 | 115 in·lb | |
| Speed Sensor Mounting Screws | 3.9 | 0.40 | 35 in·lb | L |
| Starter Motor Ground Bolt | 8.8 | 0.90 | 78 in·lb | L |
| Starter Motor Mounting Bolts | 8.8 | 0.90 | 78 in·lb | L |
| Starter Motor Terminal Nut | 8.8 | 0.90 | 78 in·lb | |
| Starter Motor Through Bolts | 6.4 | 0.65 | 57 in·lb | L, R |
| Starter Relay Terminal Bolts | 5.5 | 0.56 | 49 in·lb | |
| Stator Coil Bolts | 12 | 1.2 | 106 in·lb | L |
| Stator Coil Grommet Holder Plate Bolts | 8.8 | 0.90 | 78 in·lb | L |
| Timing Rotor Bolt | 20 | 2.0 | 15 | L |
| Vehicle-down Sensor Mounting Screws | 1.5 | 0.15 | 13 in·lb | |
| Water Temperature Sensor | 14.7 | 1.5 | 11 | |
| Water Temperature Sensor (for Meter Unit) | 8.8 | 0.90 | 78 in·lb | |

The table below, relating tightening torque to thread diameter, lists the basic torque for the bolts and nuts. Use this table for only the bolts and nuts which do not require a specific torque value. All of the values are for use with dry solvent-cleaned threads.

### Basic Torque for General Fasteners (stainless bolt and nut)

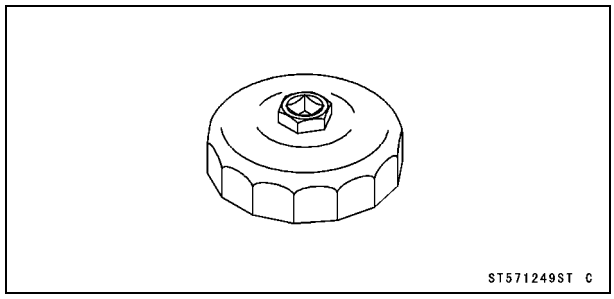
| Threads Diameter (mm) | Torque | | |
|---|---|---|---|
| | N·m | kgf·m | ft·lb |
| 6 | 5.9 ~ 8.8 | 0.60 ~ 0.90 | 52 ~ 78 in·lb |
| 8 | 16 ~ 22 | 1.6 ~ 2.2 | 12 ~ 16 |
| 10 | 30 ~ 41 | 3.1 ~ 4.2 | 22 ~ 30 |

## Specifications

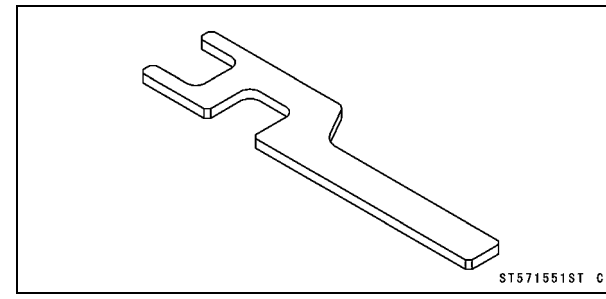
| Item | Standard | Service Limit |
|---|---|---|
| **Fuel System** | | |
| Throttle Lever Free Play | About 2 mm (0.08 in.) | – – – |
| **Engine Lubrication System** | | |
| Engine Oil: | | |
| Type | API SG, SH, SJ, SL or SM with JASO MA, MA1 or MA2 | – – – |
| Viscosity | SAE 10W-40 | – – – |
| Capacity | 4.0 L (4.2 US qt, when filter is not removed)<br>4.2 L (4.4 US qt, when filter is removed)<br>5.0 L (5.3 US qt, when engine is completely dry) | – – – |
| **Engine Top End** | | |
| Valve Clearance: | | |
| Intake | 0.15 ~ 0.24 mm (0.0059 ~ 0.0094 in.) | – – – |
| Exhaust | 0.22 ~ 0.31 mm (0.0087 ~ 0.0122 in.) | – – – |
| **Electrical System** | | |
| Spark Plug: | | |
| Type | NGK CR9EK | – – – |
| Gap | 0.7 ~ 0.8 mm (0.028 ~ 0.032 in.) | – – – |

## Special Tools

**Oil Filter Wrench:**
**57001-1249**




**Shaft Wrench:**
**57001-1551**



## Periodic Maintenance Procedures

## Fuel System

### *Throttle Control System Inspection*

- Check the throttle lever free play [A].

**Throttle Lever Free Play**
**Standard: About 2 mm (0.08 in.)**

★If the free play is incorrect, check the throttle cable.

- Check that the throttle lever moves smoothly from full open to close, and the throttle closes quickly and completely in all steering positions by the return spring.

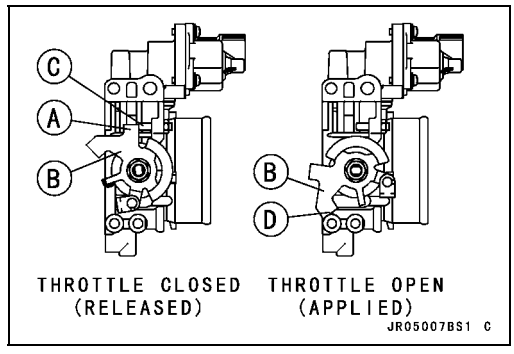
★If the throttle lever does not return properly, check the throttle cable routing, cable adjustments, and cable damage. Then lubricate the throttle cable.

- Run the engine at the idle speed, and turn the handlebar all the way to the right and left to ensure that the idle speed does not change.

***NOTICE***

**Operating the engine without cooling water for more than 15 seconds, especially at high rpm, will cause severe engine and exhaust system damage. To avoid engine damage, do not run the engine without providing sufficient cooling water.**

★If the idle speed increase, check the throttle cable adjustment and the cable routing.




- Remove the seats (see Seat Removal in the Hull/Engine Hood chapter).
- Check throttle cable adjustment.
- With the throttle lever released, the upper stop [A] on the throttle pivot arm [B] should rest against the stopper [C] on the throttle body, and there should be slight slack in the throttle cable.
- When the throttle lever is fully applied (pulled), the lower stop [D] on the pivot arm should be all the way up against the stopper on the throttle body.

★If necessary, adjust the throttle cable.

- Loosen and turn the locknuts [A] at the bracket until the upper stop on the pivot arm hits against the stopper on the throttle body with slight cable slack.
- Tighten the locknuts securely.

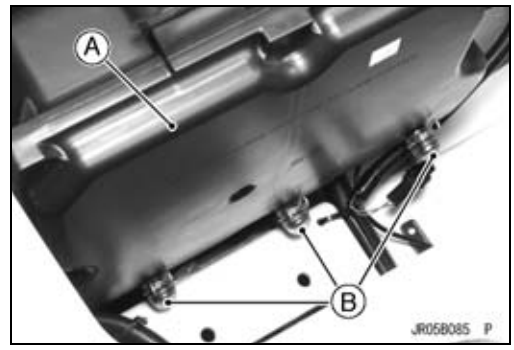
**Torque - Throttle Cable Locknuts: 19.6 N·m (2.0 kgf·m, 14 ft·lb)**

**NOTE**

○*Make sure that the throttle pivot arm stops against the stopper on the throttle body with the throttle lever released.*

## Periodic Maintenance Procedures

### *Air Box Drain Caps Inspection and Cleaning*



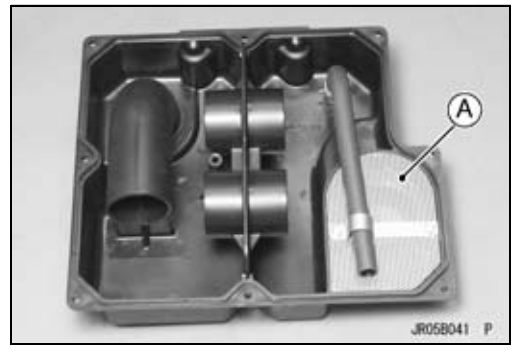

- Remove the seats (see Seat Removal in the Hull/Engine Hood chapter).
- Remove the handrail plate (see Handrail Plate Removal in the Hull/Engine Hood chapter).
- Inspect the air box [A] for water inside with its drain caps [B].

★If there is water in the caps, remove the caps and discharge the water.

**NOTE**

○*Be sure to have a rag or cloth underneath for possible oily water.*

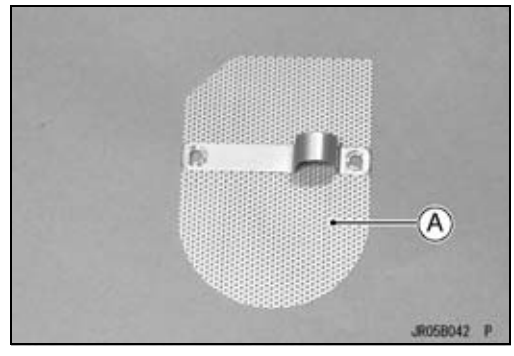
### *Air Box Inspection and Cleaning*




- Remove:

  Air Box (see Air Box Removal in the Fuel System (DFI) chapter)

  Flame Arrester [A] (see Air Box Disassembly in the Fuel System (DFI) chapter)

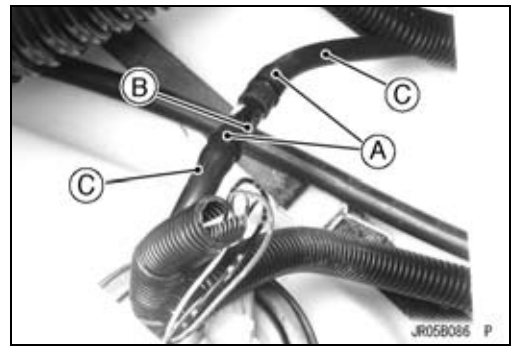



- Clean the flame arrester [A].
- Visually inspect the flame arrester for damage.

★If necessary, replace it with a new one.

### *Fuel Vent Check Valve Inspection*

The fuel vent check valve is mounted in the fuel tank vent hose to prevent fuel from spilling during riding. Air can flow into the tank to allow fuel to be drawn out by the fuel pump, but fuel cannot flow out the check valve.



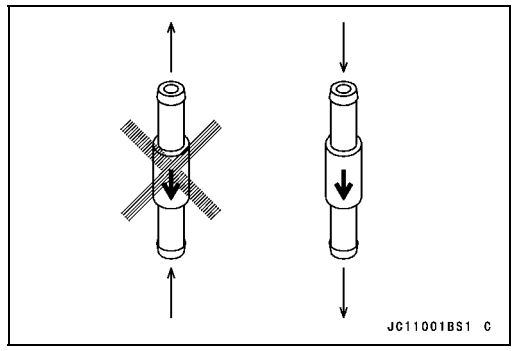

- Remove the center access cover (see Center Access Cover Removal/Installation in the Hull/Engine Hood chapter).
- Cut off the bands [A].
- Pull out each end of the fuel vent check valve [B] from the vent hoses [C].

## Periodic Maintenance Procedures

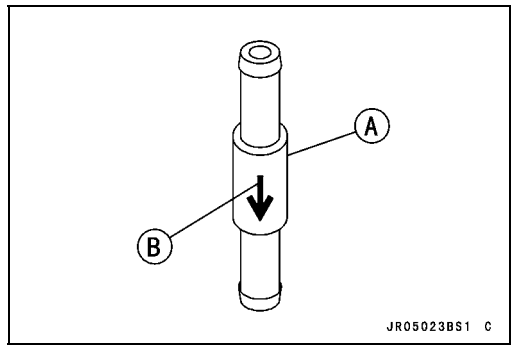
- Blow through the fuel vent check valve from each end.

★If the check valve will allow air to flow as shown, it is OK.

★If air will flow through the check valve in both direction or in neither direction, the check valve must be replaced.

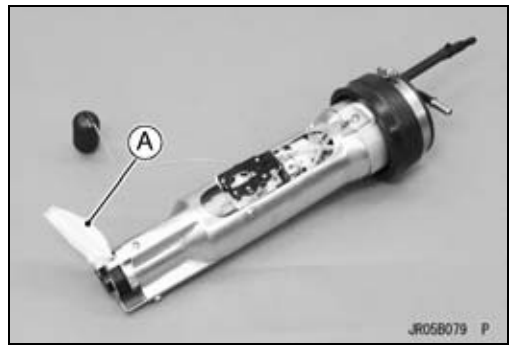



- The fuel vent check valve [A] must be mounted so that the arrow [B] on its case is pointing toward the fuel tank.




### *Fuel Pump Screen Cleaning*

- Remove the fuel pump (see Fuel Pump Removal in the Fuel System (DFI) chapter).
- Wash the fuel pump screen [A] in non-flammable of high -flash point solvent. Use a soft brush to remove any contaminants trapped in the screens.




**⚠ WARNING**

**Gasoline and low flash-point solvents are extremely flammable and can be explosive under certain conditions. To prevent a fire or explosion, clean the fuel pump screen in a well-ventilated area with a high flash-point solvent away from any ignition sources, including any appliance with a pilot light.**

### *Throttle Shaft Spring Inspection*

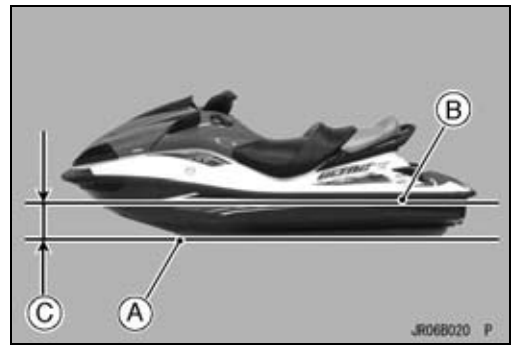
- Remove:
  Seats (see Seat Removal in the Hull/Engine Hood chapter)
- Check the throttle shaft spring [A] by pulling the throttle lever.

★If the spring is damaged or weak, replace the throttle body.

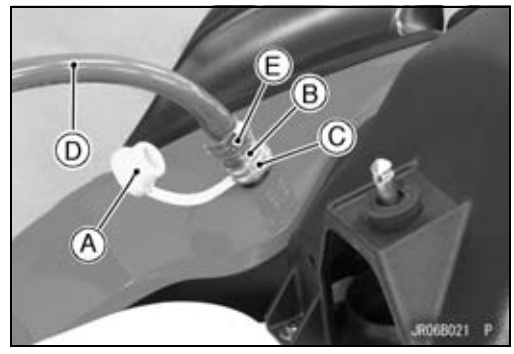
## Periodic Maintenance Procedures

### Engine Lubrication System

#### *Engine Oil Change*



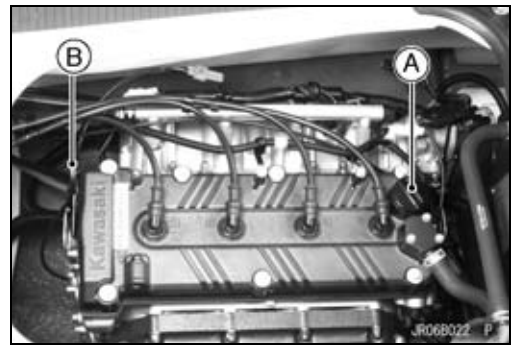

- Level the watercraft port to starboard as well as fore to aft.
  Level Ground [A]
  Side Bumper [B]
  Parallel [C]




- In a well-ventilated area, start the engine while cooling the cooling system.
  - Obtain a standard garden hose and a garden hose adapter (see Cooling System Flushing).
  - Open the front storage compartment cover.
  - Remove the flushing cap [A].
  - Screw a garden hose adapter [B] onto the flushing fitting [C].
  - Attach a garden hose [D] to a garden hose adapter and secure the hose clamp [E].
- Warm up the engine and stop it.
- Remove the garden hose and garden hose adapter.

**NOTICE**

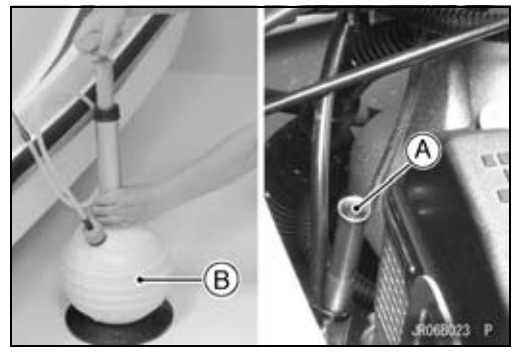
**The engine must be running before the water is turned on and the water must be turned off before the engine is stopped.**
**Do not run the engine without cooling water flow for more than 15 seconds.**




- Remove the seats (see Seat Removal in the Hull/Engine Hood chapter).
- Remove the oil filler cap [A] and the dipstick [B].

**NOTICE**

**Dirt and other foreign materials can cause serious engine damage. To prevent engine damage, do not allow dirt or foreign materials to enter the engine.**



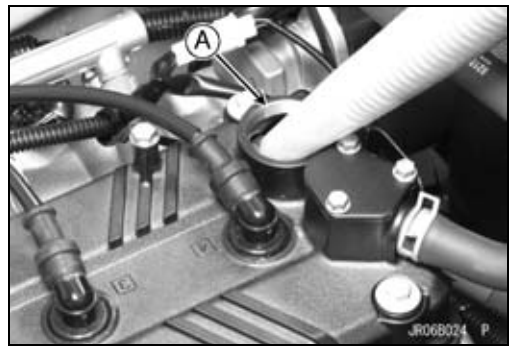

- Drain the oil thoroughly from the dipstick tube [A] using a commercially-available vacuum pump [B].

**⚠ WARNING**

**Used engine oil is toxic and pollutes the environment. To protect the environment, do not discard used engine oil; always return it to an authorized recycling center.**

## Periodic Maintenance Procedures

- Pour in the specified type and amount of oil through the oil filler opening [A].




**Engine Oil**

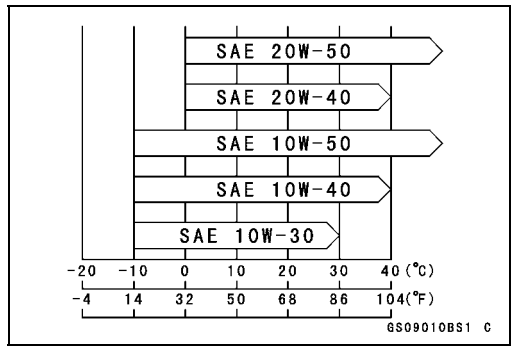
**Grade:** **API SG, SH, SJ, SL or SM with JASO MA, MA1 or MA2**

**Viscosity:** **SAE 10W-40**

**Amount:** **4.0 L (4.2 US qt, when filter is not removed)**

**4.2 L (4.4 US qt, when filter is removed)**

**5.0 L (5.3 US qt, when engine is completely dry)**




**NOTE**

○*Do not add any chemical additive to the oil. Oils fulfilling the above requirements are fully formulated and provide adequate lubrication for the engine.*

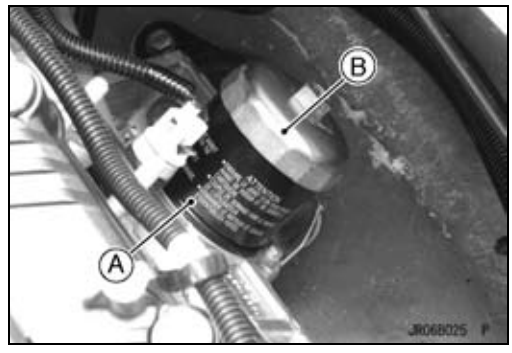
○*Although 10W-40 engine oil is the recommended oil for most conditions, the oil viscosity may need to be changed to accommodate atmospheric conditions in your riding area.*

- Install the filler cap.
- Check the oil level (see Oil Level Inspection in the Engine Lubrication System chapter).

### *Oil Filter Replacement*

- Remove:
  Intake Manifold (see Intake Manifold Removal in the Fuel System (DFI) chapter)
- Drain the engine oil (see Engine Oil Change).
- Place a rag or cloth under the oil filter to receive the remaining oil.
- Remove the oil filter [A] with the oil filter wrench [B].

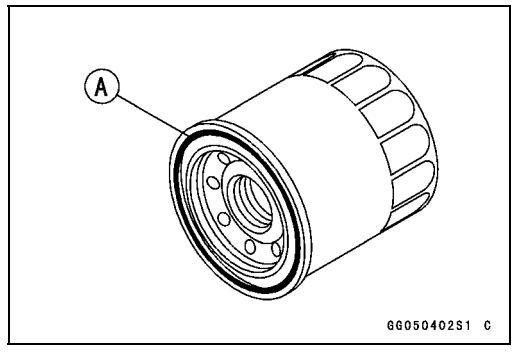
**Special Tool - Oil Filter Wrench: 57001-1249**




- Replace the filter with a new one.
- Apply engine oil to the gasket [A] before installation.
- Tighten the filter with the oil filter wrench.

**Torque - Oil Filter: 18 N·m (1.8 kgf·m, 13 ft·lb)**

- Pour in the specified type and amount of oil (see Engine Oil Change).



## Periodic Maintenance Procedures

### Engine Top End

#### *Valve Clearance Inspection*

**NOTE**

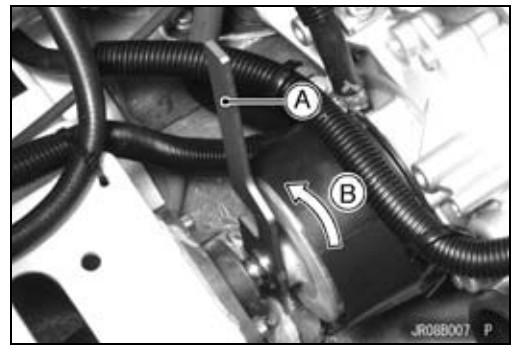
○*Valve clearance must be checked and adjusted when the engine is cold (at room temperature).*

● Remove:
Handrail Plate (see Handrail Plate Removal in the Hull/Engine Hood chapter)
Cylinder Head Cover (see Cylinder Head Cover Removal in the Engine Top End chapter)

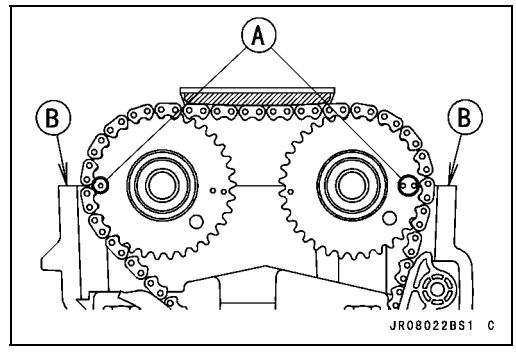
● Position the crankshaft at #1, #4 piston TDC as follows.

○Using the shaft wrench [A], turn the crankshaft counterclockwise [B] and set the crankshaft at #1, #4 piston TDC.

**Special Tool - Shaft Wrench: 57001-1551**



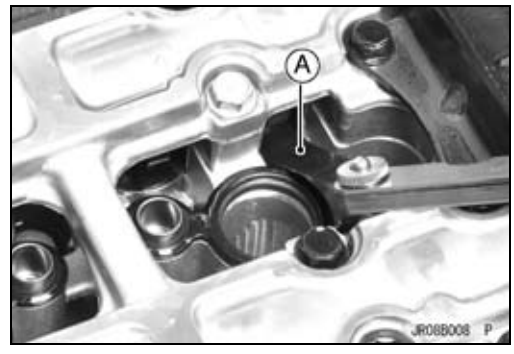

○The timing marks [A] must be aligned with the cylinder head upper surface [B] as shown in the figure.




● Measure the valve clearance between the cam and the valve lifter with a thickness gauge [A].

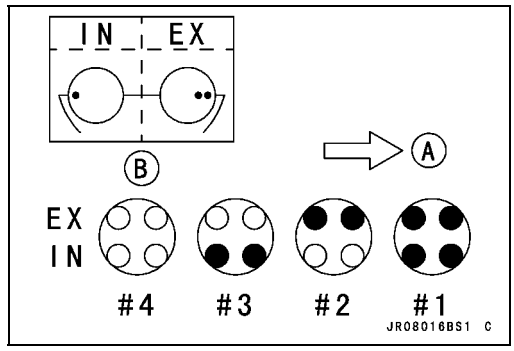
**Valve Clearance**
**Standard:**

| | |
|---|---|
| **Intake** | **0.15 ~ 0.24 mm (0.0059 ~ 0.0094 in.)** |
| **Exhaust** | **0.22 ~ 0.31 mm (0.0087 ~ 0.0122 in.)** |

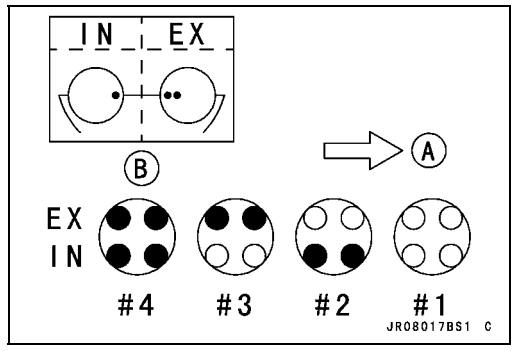


## Periodic Maintenance Procedures

○**When positioning #1 piston TDC at the end of the compression stroke:**
Intake Valve Clearance of #1 and #3 Cylinders
Exhaust Valve Clearance of #1 and #2 Cylinders
Measuring Valve [●]
Bow [A]
Camshaft Sprocket Position [B]




○**When positioning #4 piston TDC at the end of the compression stroke:**
Intake Valve Clearance of #2 and #4 Cylinders
Exhaust Valve Clearance of #3 and #4 Cylinders
Measuring Valve [●]
Bow [A]
Camshaft Sprocket Position [B]

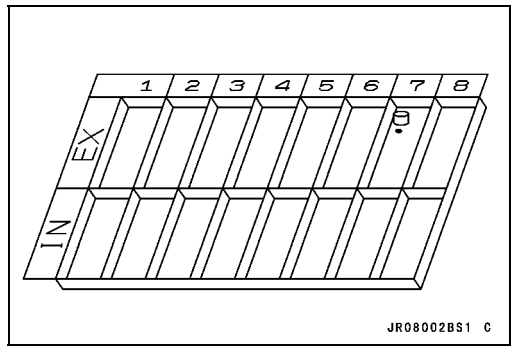



★If the valve clearance is not within the specified range, first record the clearance, and then adjust it.

● To change the valve clearance, remove the camshaft chain tensioner, camshafts and valve lifters. Replace the shim with one of a different thickness.

**NOTE**

○*Mark and record the locations of the valve lifter and shim so that they can be reinstalled in their original positions.*




● Clean the shim to remove any dust or oil.
● Measure the thickness of the removed shim [A].
● Select a new shim thickness calculation as follows.

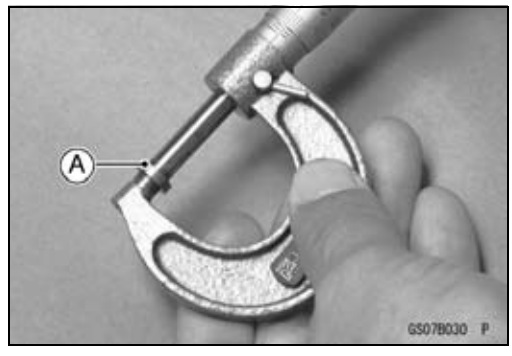
a + b – c = d

[a] Present Shim Thickness

[b] Measured Valve Clearance

[c] Specified Valve Clearance (Mean Value = 0.265 mm (Exhaust), 0.195 mm (Intake))

[d] Replace Shim Thickness



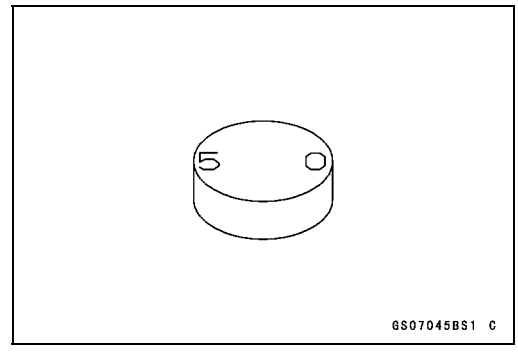

**Example (Exhaust):**
2.100 + 0.6 – 0.265 = 2.435 mm

○Exchange the shim for the 2.450 size shim.

## Periodic Maintenance Procedures

**Adjustment Shims**

| Thickness | Part Number | Mark |
|---|---|---|
| 2.000 | 92025-1870 | 0 |
| 2.050 | 92025-1871 | 5 |
| 2.100 | 92025-1872 | 10 |
| 2.150 | 92025-1873 | 15 |
| 2.200 | 92025-1874 | 20 |
| 2.250 | 92025-1875 | 25 |
| 2.300 | 92025-1876 | 30 |
| 2.350 | 92025-1877 | 35 |
| 2.375 | 92180-1058 | 38 |
| 2.400 | 92025-1878 | 40 |
| 2.425 | 92025-1982 | 43 |
| 2.450 | 92025-1879 | 45 |
| 2.475 | 92025-1983 | 48 |
| 2.500 | 92025-1880 | 50 |
| 2.525 | 92025-1984 | 53 |
| 2.550 | 92025-1881 | 55 |
| 2.575 | 92025-1985 | 58 |
| 2.600 | 92025-1882 | 60 |
| 2.625 | 92180-1059 | 63 |
| 2.650 | 92025-1883 | 65 |
| 2.675 | 92180-1194 | 68 |
| 2.700 | 92025-1884 | 70 |
| 2.725 | 92180-1195 | 73 |
| 2.750 | 92025-1885 | 75 |
| 2.775 | 92180-1196 | 78 |
| 2.800 | 92025-1886 | 80 |
| 2.850 | 92025-1887 | 85 |
| 2.900 | 92025-1888 | 90 |
| 2.950 | 92025-1889 | 95 |
| 3.000 | 92025-1890 | 00 |



## Periodic Maintenance Procedures

**NOTICE**

**Be sure to remeasure the clearance after selecting a shim. The clearance can be out of the specified range because of the shim tolerance.**

○If there is no valve clearance, use a shim that is a few sizes smaller, and remeasure the valve clearance.

- When installing the shim, face the marked side toward the valve lifter. At this time, apply engine oil to the shim or the valve lifter to keep the shim in place during camshaft installation.

**NOTICE**

**Using shim stock under the shim may cause it to pop out at high rpm and cause severe engine damage. Do not put shim stock under the shim. Grinding the shim may cause it to fracture, causing severe engine damage. Do not grind the shim.**

- Apply molybdenum disulfide oil solution to the valve lifter surface and install the lifter.
- Install the camshafts (see Camshaft Installation in the Engine Top End chapter).
- Recheck the valve clearance and readjust if necessary.
- Install the removed parts (see appropriate chapters).

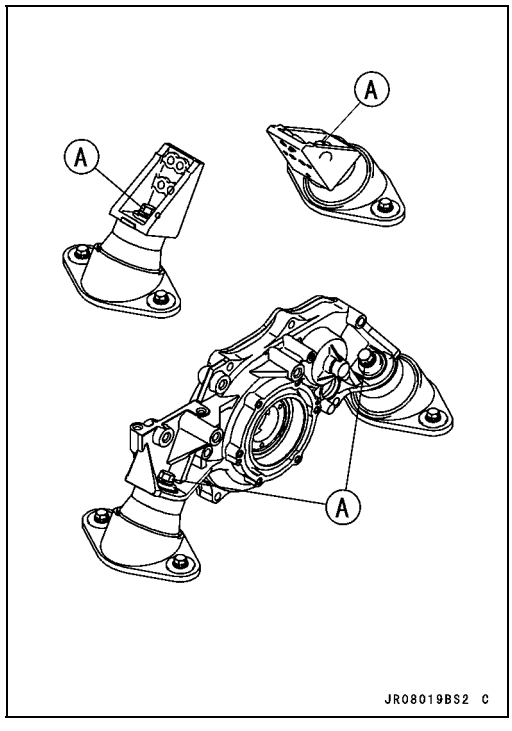
### *Engine Mounting Bolts Inspection and Tightness*

- Check the tightness of the engine mounting bolts [A].

★If there are loose bolts, remove the bolts.

- Apply a non-permanent locking agent to the engine mounting bolts and tighten them.

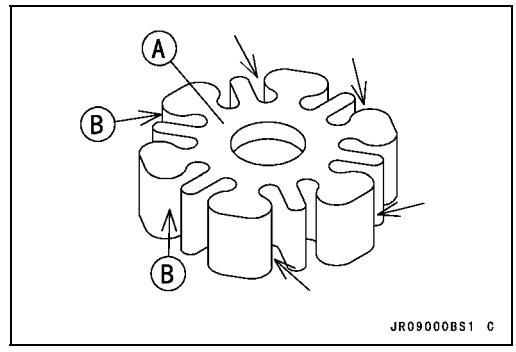
**Torque - Engine Mounting Bolts: 36.3 N·m (3.7 kgf·m, 27 ft·lb)**



## Periodic Maintenance Procedures

## Engine Bottom End

### *Coupling Damper Inspection*




- Remove:
  Engine (see Engine Removal in the Engine Removal/Installation chapter)
- Remove the coupling damper [A] and inspect it for wear [B] and deterioration.

★If it is grooved or misshapen, replace it with a new damper (see Coupling Installation in the Engine Bottom End chapter).

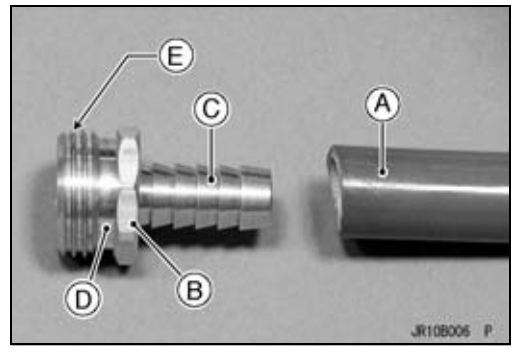
★If there is any doubt as to coupler condition, replace it.

## Cooling and Bilge Systems

### *Cooling System Flushing*

To prevent sand or salt deposits from accumulating in the cooling system, it must be flushed occasionally. Flush the system according to the Periodic Maintenance Chart, after each use in salt water, or whenever there is reduced water flow from the bypass outlet on the right side of the hull.

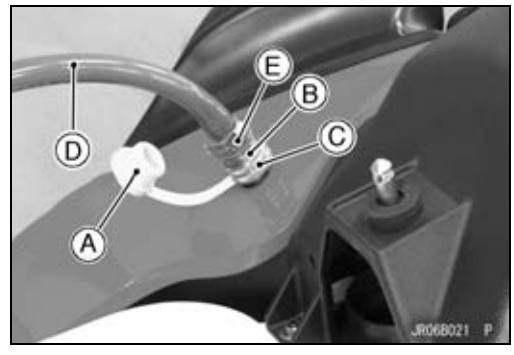
- Obtain a standard garden hose [A] and a garden hose adapter [B] as shown in the figure.
  Garden Hose Fitting of Adapter [C]
  Flushing Fitting of Adapter [D]
  Thread: Rp 3/4 [E]



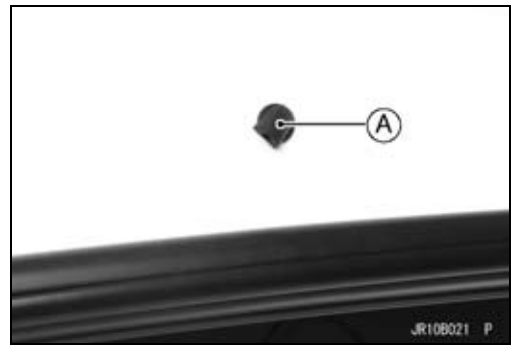

**NOTE**

○*Optional part (P/No. 92005-3748) is available as a garden hose adapter.*

- Open the front storage compartment cover.
- Remove the flushing cap [A].
- Screw a garden hose adapter [B] onto the flushing fitting [C].
- Attach a garden hose [D] to a garden hose adapter and secure the hose clamp [E].




- Start the engine and allow it to idle before turning on the water.




***NOTICE***

**If the water is turned on before the engine is running, water may flow back through the exhaust pipe and into the engine, causing severe engine damage. To prevent engine damage, be sure the engine is running before turning the water on.**

- Immediately turn on the water and adjust the flow so that a little trickle of water comes out of the bypass outlet [A] on the right side of the hull.

- Leave the engine idle for several minutes with the water running.
- Turn off the water. Leave the engine idling.
- Rev the engine a few times to clear the water out of the exhaust system.

**NOTICE**

**Operating the engine without cooling water for more than 15 seconds, especially at high rpm, will cause severe engine and exhaust system damage. To avoid engine damage, do not run the engine without providing sufficient cooling water.**

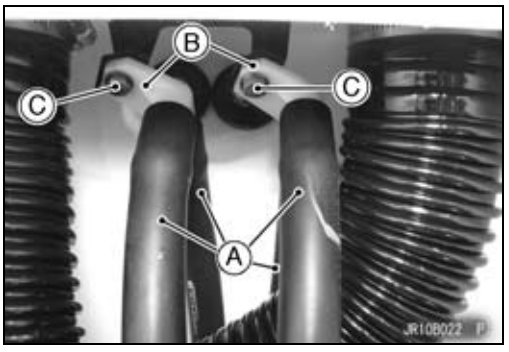
- Stop the engine, remove the garden hose and the adapter.
- Install the flushing cap securely.

**Torque - Flushing Cap: 0.90 N·m (0.092 kgf·m, 8.0 in·lb)**

### *Bilge System Flushing*

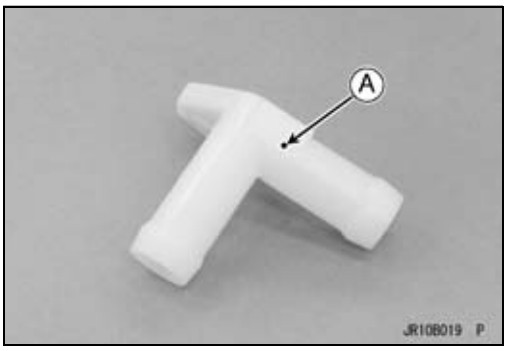
To prevent clogging, the bilge system should be flushed out according to the Periodic Maintenance Chart, or whenever you suspect it is blocked.

- Remove:
  Seats (see Seat Removal in the Hull/Engine Hood chapter)
  Handrail Plate (see Handrail Plate Removal in the Hull/Engine Hood chapter)
- Remove the bilge hoses [A] from the breathers [B].
- Remove:
  Bolts [C]
  Breathers




- Install the bilge hose (from the hull bottom) to the garden hose, turn the water on, and flush it out for about a minute. During this procedure, water will flow into the engine compartment. Do not allow a large amount of water to accumulate in the engine compartment. Remove the drain screws in the stern to drain the engine compartment.
- Install the other hose (from the hull bulkhead) to the garden hose, turn the water on, and flush it out for several minutes.

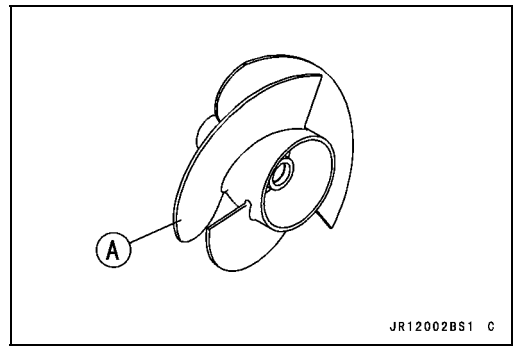
- Be sure the small hole [A] in the breather is open before installation.
- Install:
  Breathers
  Bolts
  Bilge Hoses



## Periodic Maintenance Procedures

## Pump and Impeller

### *Impeller Inspection*



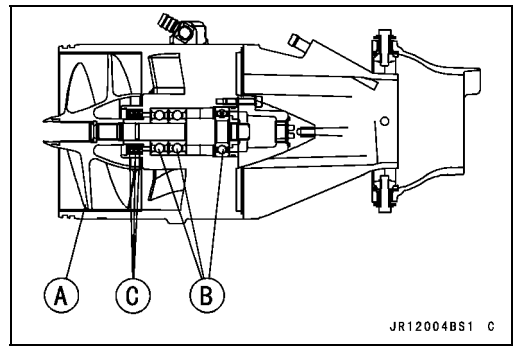

- Remove:
  Impeller (see Pump Disassembly in the Pump and Impeller chapter)
- Visually inspect the impeller [A].

★If there is pitting, deep scratches, nicks or other damage, replace the impeller.

**NOTE**

○*Minor nicks and gouges in the impeller blades can be removed with abrasive paper or careful filing. Smooth leading edges are especially important to avoid cavitation.*

### *Jet Pump Bearing and Seal Inspection*




- Remove:
  Pump (see Pump Removal in the Pump and Impeller chapter)
- Spin the impeller [A] lightly, and check for smoothly turn, roughness, binding or noise.

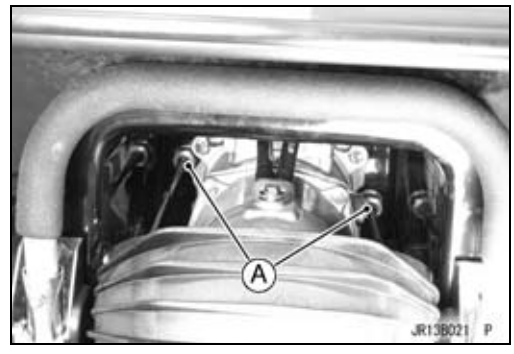
★If roughness, binding or noise is found, replace the jet pump bearings [B] and grease seals [C] (see Pump Disassembly in the Pump and Impeller chapter).

**NOTE**

○*It is not necessary to remove the jet pump bearing for inspection. If the bearing is removed, it will need to be replaced with a new one.*

## Steering

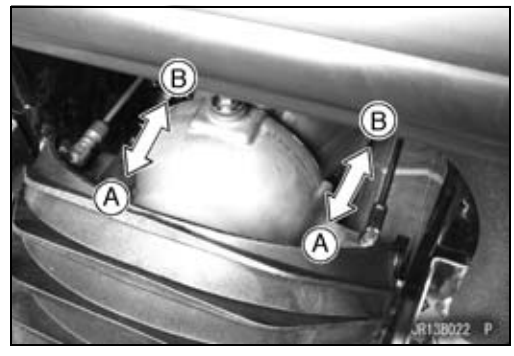
### *Steering Cable/Shift Cable Inspection*




- Check the steering cable or shift cable.

★If each cable or cable housing is kinked or frayed, replace the cables.

★If each seal [A] at either end of each cable is damaged in any way, replace the cables.




- Be certain that each cable moves freely in both directions.
- Remove the cable joints at each end of each cable.

○Remove the cable joint bolt or ball joint from the cable joint.

***NOTICE***

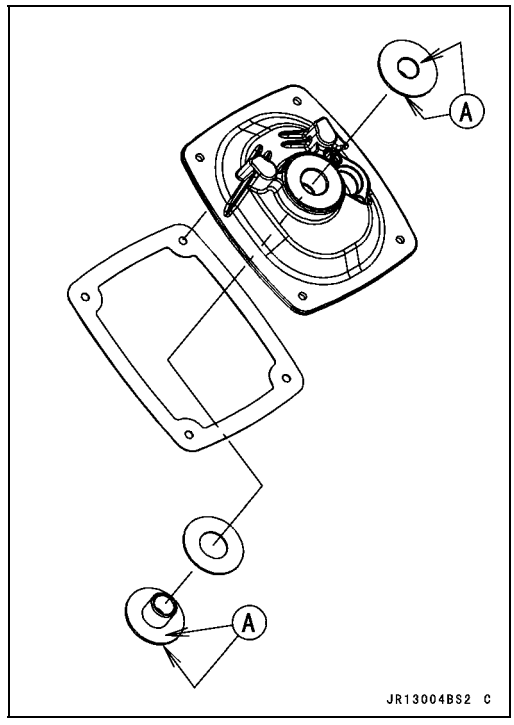
**If the watercraft is laid on its right side, water in the exhaust system may drain back into the engine a cause serious damage. Never lay the watercraft on the right side.**

○Slide the inner cable back [A] and forth [B] in each cable housings.

★If each cable does not move freely, replace it.

## Periodic Maintenance Procedures

### *Handlebar Pivot Lubrication*

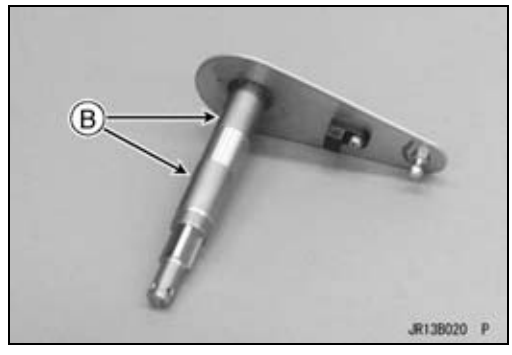



- Remove:
  Steering Holder (see Steering Removal in the Steering chapter)
- Check the bushings for damage and wear.

★If the bushings are damaged or worn, replace them.

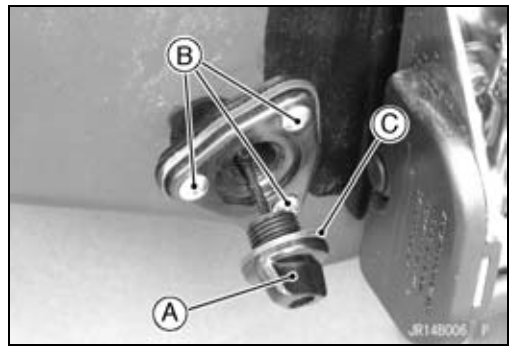
- Grease:
  Bushings [A]

Steering Shaft [B]




## Hull/Engine Hood

### *Drain Plug Inspection*




- Check the drain plugs [A] for cracks or damage and make sure the drain plug mounting screws [B] are tightened securely.
- Check the seals [C] for damage.

★If necessary, replace the drain plugs or seals.

## Periodic Maintenance Procedures

## Electrical System

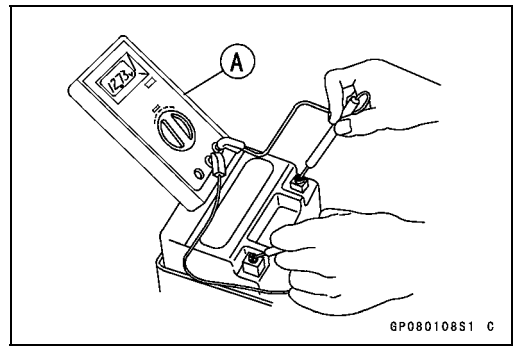
### *Battery Charging Condition Inspection*

Battery charging condition can be checked by measuring battery terminal voltage with a digital voltmeter [A].

- Disconnect the battery cables (see Battery Removal in the Electrical System chapter).

○Be sure to disconnect the negative (–) cable first.

- Measure the battery terminal voltage.

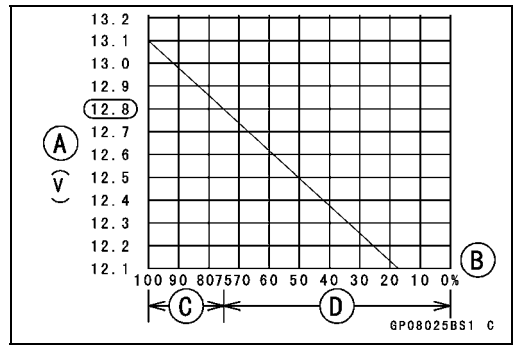



**NOTE**

○*Measure with a digital voltmeter which can be read one decimal place voltage.*

★If the reading is 12.8 V or more, no refresh charge is required, however, if the read is below the specified, refresh charge is required (see Refreshing Charge in the Electrical System chapter).

**Battery Terminal Voltage**
**Standard: 12.8 V or more**



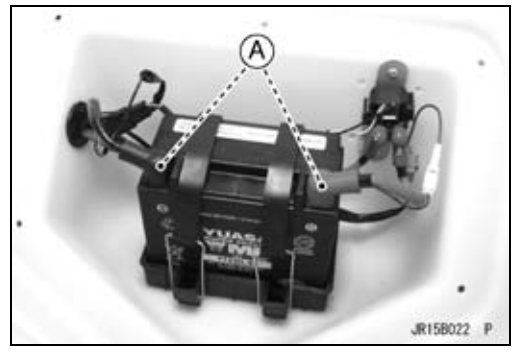

Terminal Voltage (V) [A]
Battery Charge Rate (%) [B]
Good [C]
Refresh charge is required [D]

### *Battery Terminals Inspection*

- Check the battery terminal screws [A] for tightness and make sure the terminal covers are in place.

**⚠ WARNING**

**Loose battery cables can create sparks which can cause a fire or explosion resulting in injury or death. Make sure the battery terminal screws are tightened securely and the covers are installed over the terminals.**




- Check that the battery terminals are not corroded.

★If necessary, remove the battery (see Battery Removal in the Electrical System chapter) and clean the terminals and cable ends using a solution of baking soda and water.

- After attaching both cables, coat the terminals and cable ends with grease to prevent corrosion.

### *Spark Plug Inspection*

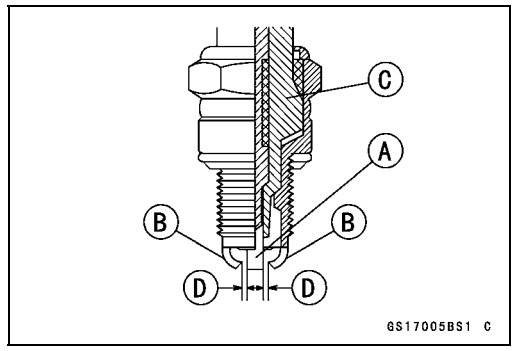
- Remove:
  Seats (see Seat Removal in the Hull/Engine Hood chapter)
  Spark Plug Caps
- Remove the spark plugs using the 16 mm (0.63 in.) plug wrench [A] vertically.

**Owner's Tool - Spark Plug Wrench, 16 mm: 92110-1145**

## Periodic Maintenance Procedures

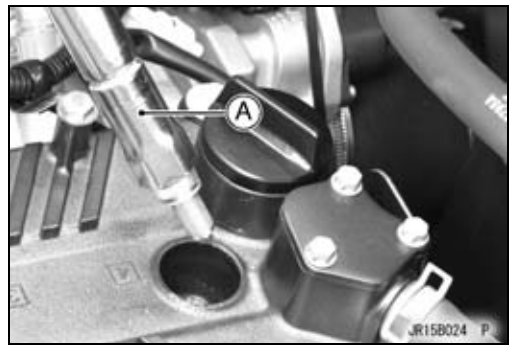
● Visually inspect the spark plugs.
★If the spark plug center electrode [A] and/or side electrode [B] are corroded or damaged, or if the insulator [C] is cracked, replace the spark plug.
● Measure the gap [D] with a wire-type thickness gauge.
★If the gap is incorrect, replace the spark plug.

**Spark Plug Gap: 0.7 ~ 0.8 mm (0.028 ~ 0.032 in.)**




● Insert the spark plug vertically into the plug hole with the spark plug installed in the plug wrench [A], and finger -tighten it first.

**Owner's Tool - Spark Plug Wrench, 16 mm: 92110-1145**




***NOTICE***

**Tightening the spark plug with the wrench at an angle may break the spark plug insulator. To avoid breaking the insulator, be sure the wrench fits firmly on the plug at a right angle.**

● Tighten:

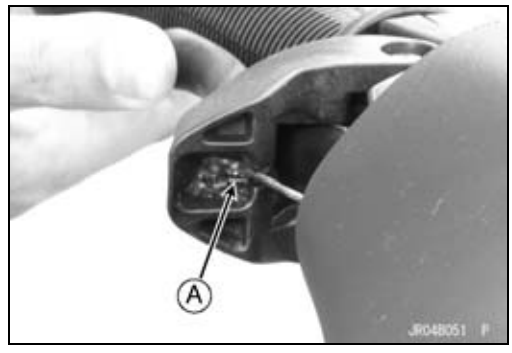
**Torque - Spark Plugs: 13 N·m (1.3 kgf·m, 115 in·lb)**

● Be sure to install the plug caps so that the plug cap leads are positioned at a right angle to the engine center line (see Cable, Wire and Hose Routing section in the Appendix chapter).
● Be sure the spark plug caps are installed by pulling up it lightly.

## Lubrication

As in all marine craft, adequate lubrication and corrosion protection is an absolute necessity to provide long, reliable service. Refer to the Periodic Maintenance Chart for the frequency of the following items:

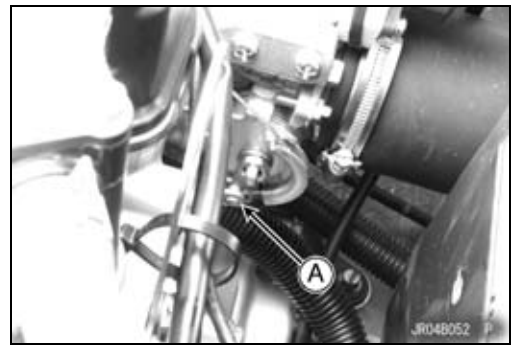
● Lubricate the following with grease.
○Pull the throttle lever and hold it.
**Throttle Cable End [A] at Throttle Lever**



## Periodic Maintenance Procedures

○Remove the seats (see Seat Removal in the Hull/Engine Hood chapter).

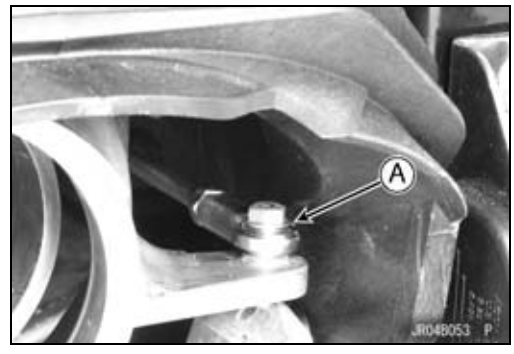
**Throttle Cable End [A] at Throttle Body**




○Remove the steering holder (see Steering Removal in the Steering chapter).

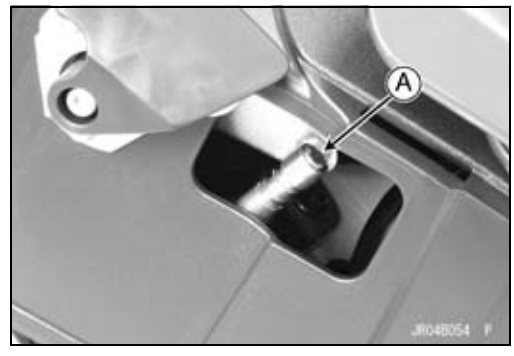
**Steering Cable Ball Joint [A] at Steering Shaft**

**Steering Cable Joint [A]**

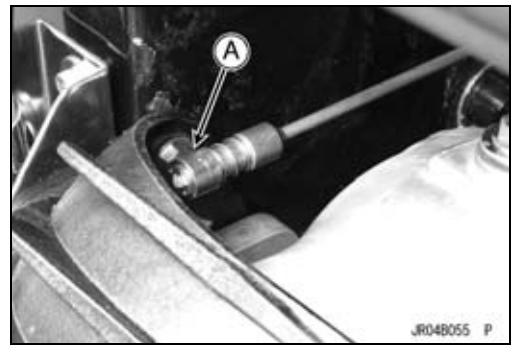



○Remove the left side cover (see Side Cover Removal in the Hull/Engine Hood chapter).

**Shift Cable Ball Joint [A] at Shift Lever**

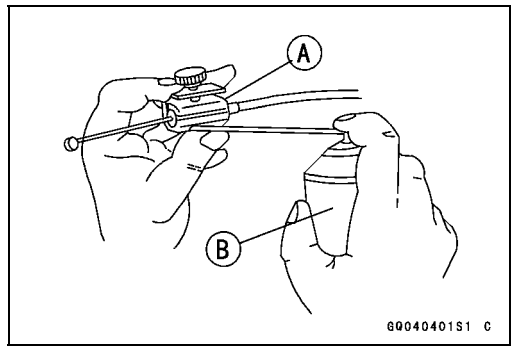



**Shift Cable Ball Joint [A] at Reverse Bucket**

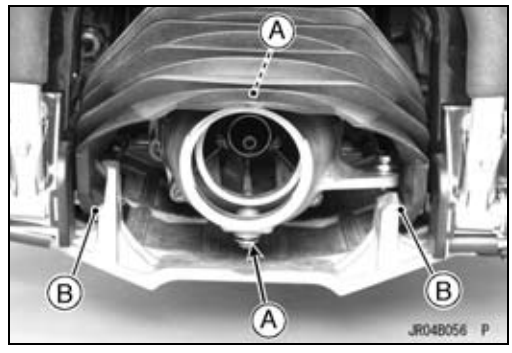


## Periodic Maintenance Procedures

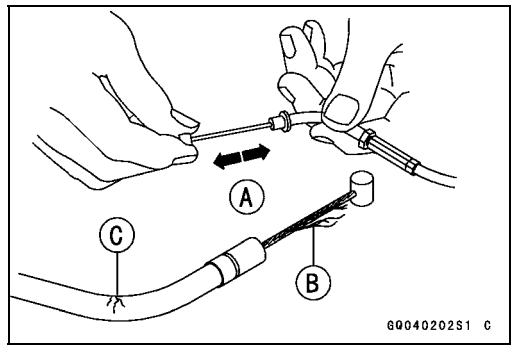
● Lubricate the following with a penetrating rust inhibitor [B].
**Throttle Cable [A]**




**Steering Nozzle Pivots [A]**
**Reverse Bucket Pivots [B]**




● With the cable disconnected at both ends, the cable should move freely [A] within the cable housing.
★If cable movement is not free after lubricating, if the cable is frayed [B], or if the cable housing is kinked [C], replace the cable.



## Periodic Maintenance Procedures

### All Hoses, Hose Clamps, Nuts, Bolts and Fasteners Check

#### *Nuts, Bolts, and Fasteners Tightness Inspection*

● Check the tightness of the bolts and nuts listed here. Also, check to see that each cotter pin is in place and in good condition.

**NOTE**

○*For the engine fasteners, check the tightness of them when the engine is cold (at room temperature).*

★If there are loose fasteners, retighten them to the specified torque following the specified tightening sequence. Refer to the appropriate chapter for torque specifications. If torque specifications are not in the appropriate chapter, see the Standard Torque Table. For each fastener, first loosen it by 1/2 turn, then tighten it.

★If cotter pins are damaged, replace them with new ones.

**Nut, Bolt and Fastener to be checked**

Engine:
- Oil Filter
- Engine Mounting Bolts (and bracket bolts)
- Engine Damper Mounting Bolts
- Cylinder Head Cover Bolts
- Cylinder Head Bolts
- Crankcase Bolts

Drive Shaft, Pump, and Impeller:
- Drive Shaft Holder Mounting Bolts
- Pump Mounting Bolts
- Pump Cover Mounting Bolts
- Grate Mounting Bolts
- Steering Nozzle Pivot Bolts
- Reverse Bucket Pivot Bolts

Steering:
- Handlebar Clamp Bolts
- Steering Neck Mounting Bolts
- Steering Holder Mounting Nuts
- Steering Shaft Locknut
- Steering Cable Nut
- Steering Cable Joint Bolt
- Shift Cable Nut

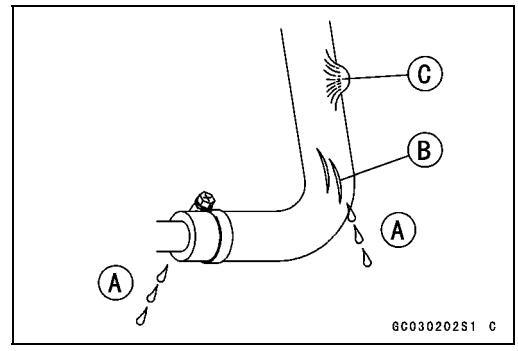
Hull and Engine Hood:
- Stabilizer Bolts
- Handrail Plate Nuts

Electrical System:
- Spark Plugs
- Battery Terminal

#### *Hose and Hose Connect Inspection*

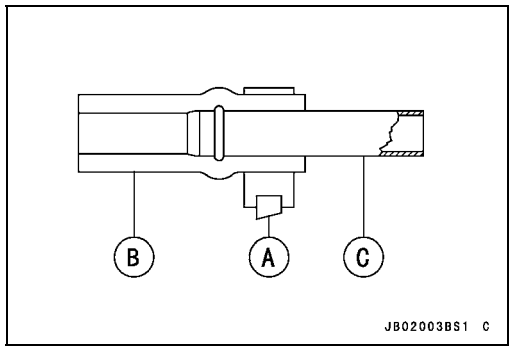
● Check the following hoses for leakage [A], hardening, cracking [B], checking, cuts, abrasions, breaks and bulges [C]. And make sure the hoses are not kinked or pinched.
- Fuel Vent Hose
- Oil Hoses
- Water Hoses
- Bilge Hoses

★If a hose is damaged in any way, replace it immediately and check all the others for damage.



## Periodic Maintenance Procedures

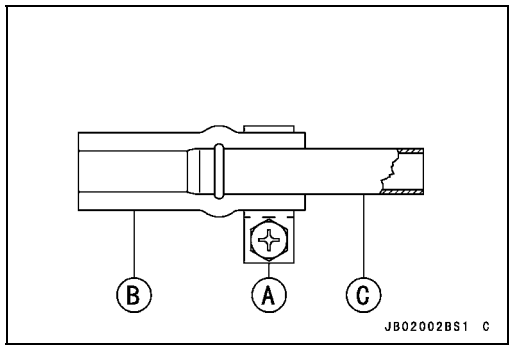
● Make sure the above hoses are routed properly and secured with the clamps away from any moving parts and sharp edged portions.
Plastic Clamp [A]
Hose [B]
Hose Fitting [C]




**NOTE**

○*The majority of bilge hoses have no clamps at the hose ends.*

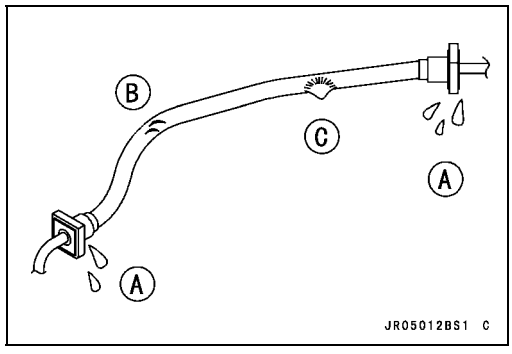
Metal Clamp [A]
Hose [B]
Hose Fitting [C]



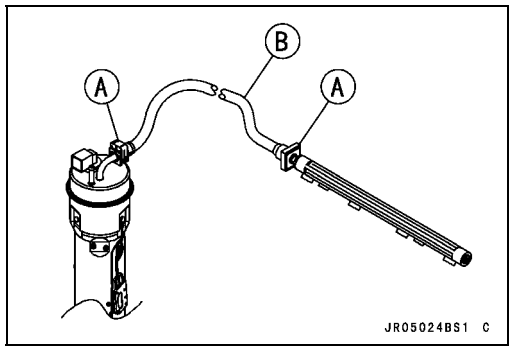

**NOTE**

○*Check the fuel and exhaust hoses for signs of wear, deterioration, damage or leakage. Replace if necessary.*
○*Make sure the above hoses are secured with the metal gear clamps away from any parts.*

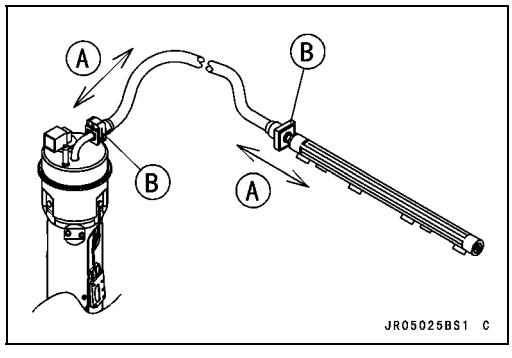
● If the watercraft is not properly handled, the high pressure inside the fuel line can cause fuel to leak [A] or the hose to burst.
● Remove:
Seats (see Seat Removal in the Hull/Engine Hood chapter)
Center Access Cover (see Center Access Cover Removal/Installation in the Hull/Engine Hood chapter)
● Check the fuel hose.
★Replace the fuel hose if any fraying, cracks [B] or bulges [C] are noticed.




● Check that the hoses are routed according to Cable, Wire, and Hose Routing section in the Appendix chapter.
★Replace the hose if it has been sharply bent or kinked.
Hose Joints [A]
Fuel Hose [B]




● Check that the hose joints are securely connected.
○Push and pull [A] the hose joint [B] back and forth more than two times, and make sure it is locked.
★If it does not locked, reinstall the hose joint.

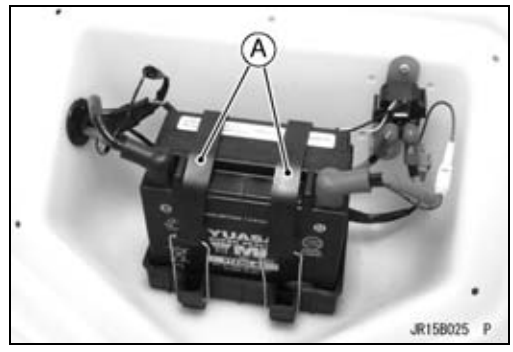



**⚠ WARNING**

**Gasoline is extremely flammable and can be explosive under certain conditions. To prevent fuel leaks, make sure the hose joint is installed correctly on the delivery pipe by sliding the joint.**

## Periodic Maintenance Procedures

### *Rubber Strap Inspection*




- Check the following rubber straps for any deterioration or damage. Pull on squeeze the straps and look for cracks.
  Battery Straps [A]
  Fuel Tank Straps
  Water Box Muffler Strap

★If a strap is damage in any way, replace it.

### *Fuel Hose Replacement*

**⚠ WARNING**

**Gasoline is extremely flammable and can be explosive under certain conditions. Turn the ignition switch OFF. Do not smoke. Make sure the area is well ventilated and free from any source of flame or sparks; this includes any appliance with a pilot light.**

- Remove the fuel hose (see Fuel Hose Removal in the Fuel System (DFI) chapter).
- Replace the fuel hose with a new one.
- When installing the fuel hose, route the hose according to Cable, Wire, and Hose Routing section in the Appendix chapter.
- When installing the fuel hose, avoid sharp bending, kinking, flattening or twisting, and route the fuel hose with a minimum of bending so that the fuel flow will not be obstructed.
- Check that the hose joints are securely connected (see Hose and Hose Connect Inspection).
- Start the engine and check the fuel hose for leaks.

# Fuel System (DFI)

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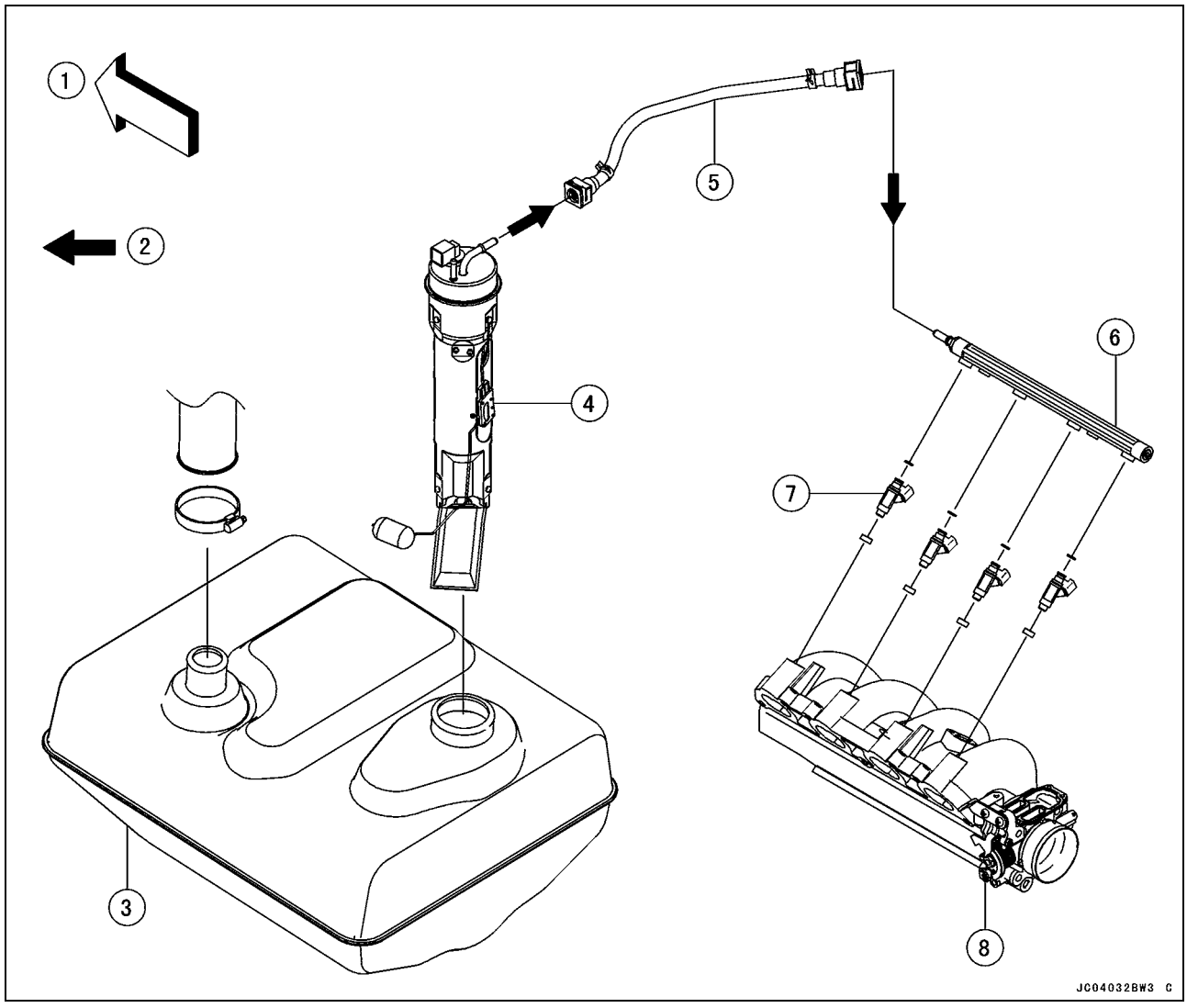
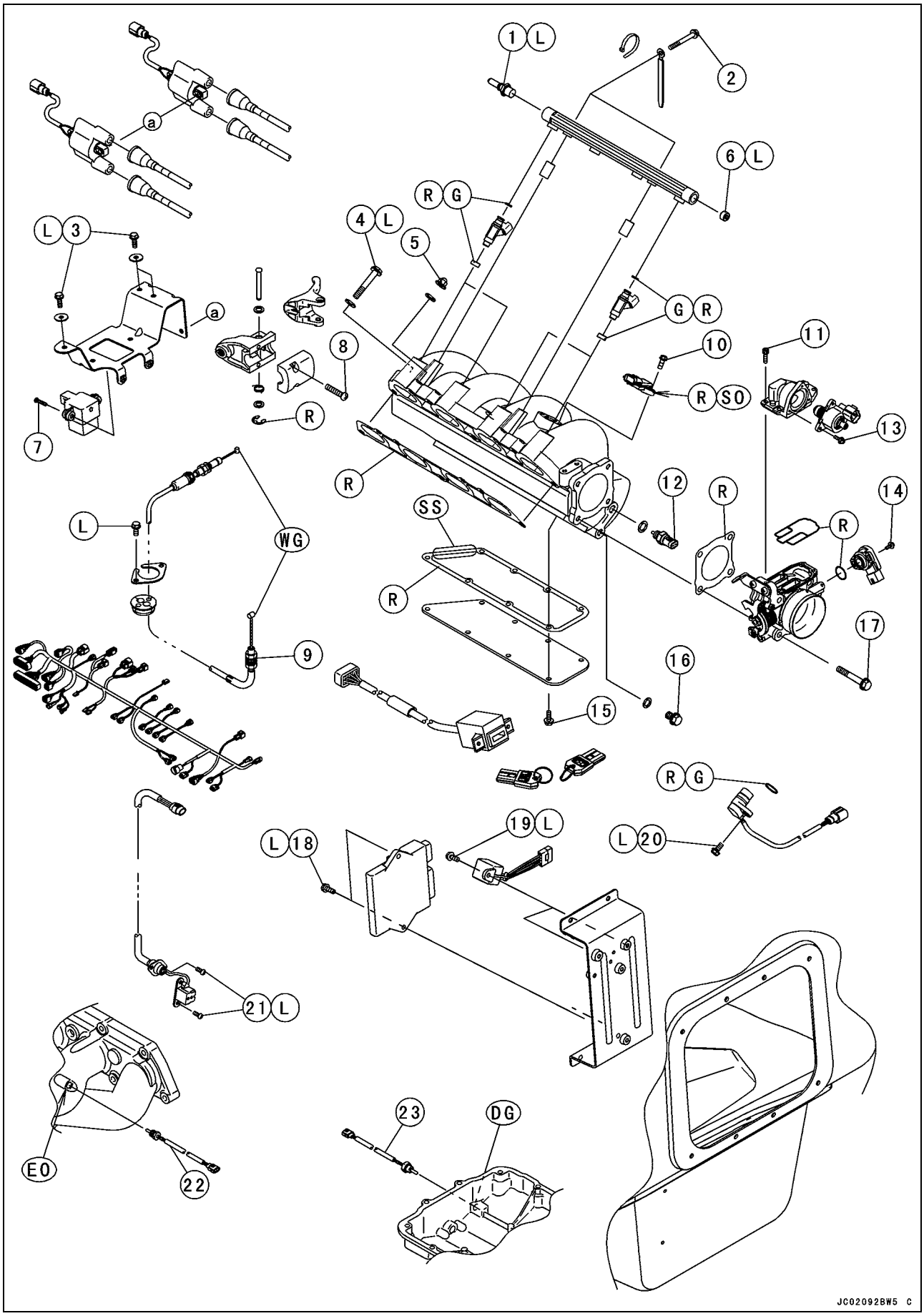
## Fuel System Diagram




1. Bow
2. Fuel Flow
3. Fuel Tank
4. Fuel Pump
5. Fuel Hose
6. Delivery Pipe Assy
7. Fuel Injectors
8. Throttle Body Assy

## Exploded View

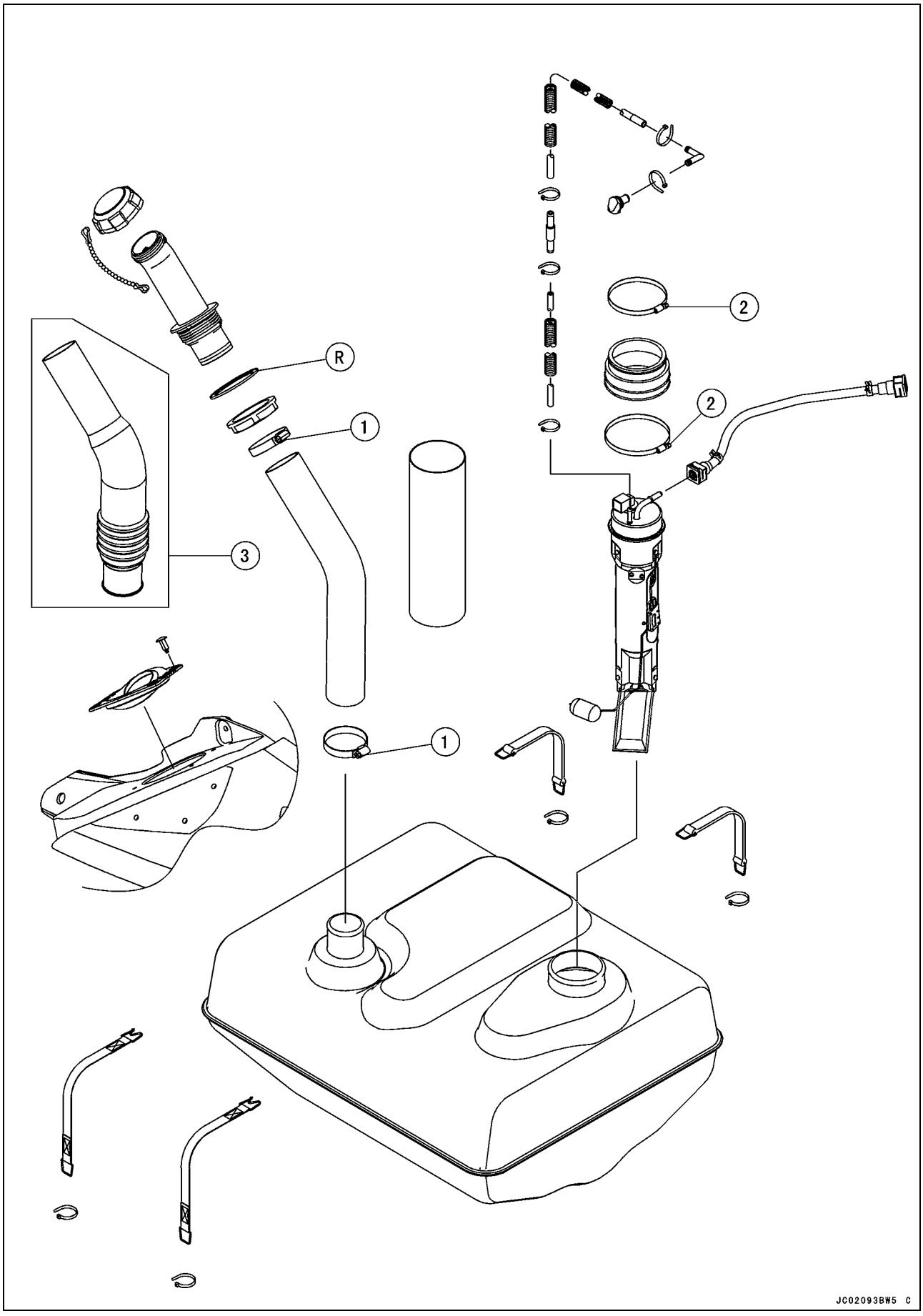


## Exploded View

| No. | Fastener | Torque | | | Remarks |
|---|---|---|---|---|---|
| | | N·m | kgf·m | ft·lb | |
| 1 | Delivery Pipe Fitting | 20 | 2.0 | 15 | L |
| 2 | Delivery Pipe Assy Mounting Bolts | 7.8 | 0.80 | 69 in·lb | |
| 3 | Bracket Bolts | 8.8 | 0.90 | 78 in·lb | L |
| 4 | Intake Manifold Mounting Bolts | 25 | 2.5 | 18 | L |
| 5 | Intake Manifold Mounting Nuts | 20 | 2.0 | 15 | |
| 6 | Delivery Pipe Plug | 11 | 1.1 | 97 in·lb | L |
| 7 | Vehicle-down Sensor Mounting Screws | 1.5 | 0.15 | 13 in·lb | |
| 8 | Throttle Case Mounting Screws | 3.9 | 0.40 | 35 in·lb | |
| 9 | Throttle Cable Locknut | 19.6 | 2.0 | 14 | |
| 10 | Intake Air Pressure Sensor Bolts | 7.8 | 0.80 | 69 in·lb | |
| 11 | ISC Actuator Mounting Bolts | 5.0 | 0.51 | 44 in·lb | |
| 12 | Intake Air Temperature Sensor | 20 | 2.0 | 15 | |
| 13 | Stepping Motor Mounting Screws | 2.0 | 0.20 | 18 in·lb | |
| 14 | Throttle Position Sensor Mounting Screws | 2.0 | 0.20 | 18 in·lb | |
| 15 | Intake Manifold Plate Bolts | 7.8 | 0.80 | 69 in·lb | |
| 16 | Intake Manifold Drain Plug | 20 | 2.0 | 15 | |
| 17 | Throttle Body Assy Mounting Bolts | 20 | 2.0 | 15 | |
| 18 | ECU Mounting Bolts | 3.0 | 0.31 | 27 in·lb | L |
| 19 | Relay Mounting Bolts | 2.5 | 0.25 | 22 in·lb | L |
| 20 | Camshaft Position Sensor Bolt | 10 | 1.0 | 89 in·lb | L |
| 21 | Crankshaft Sensor Screws | 4.5 | 0.46 | 40 in·lb | L |
| 22 | Water Temperature Sensor | 14.7 | 1.5 | 11 | |
| 23 | Oil Temperature Sensor | 15 | 1.5 | 11 | |

DG: Fill the hollow with the heat transfer grease (Heat Transfer Grease, SCH-20: 92137-1002 or equivalent).
EO: Apply engine oil.
G: Apply grease.
L: Apply a non-permanent locking agent.
R: Replacement Parts
SO: Apply silicone oil.
SS: Apply silicone sealant (92104-0004).
WG: Apply water-resistance grease.

## Exploded View

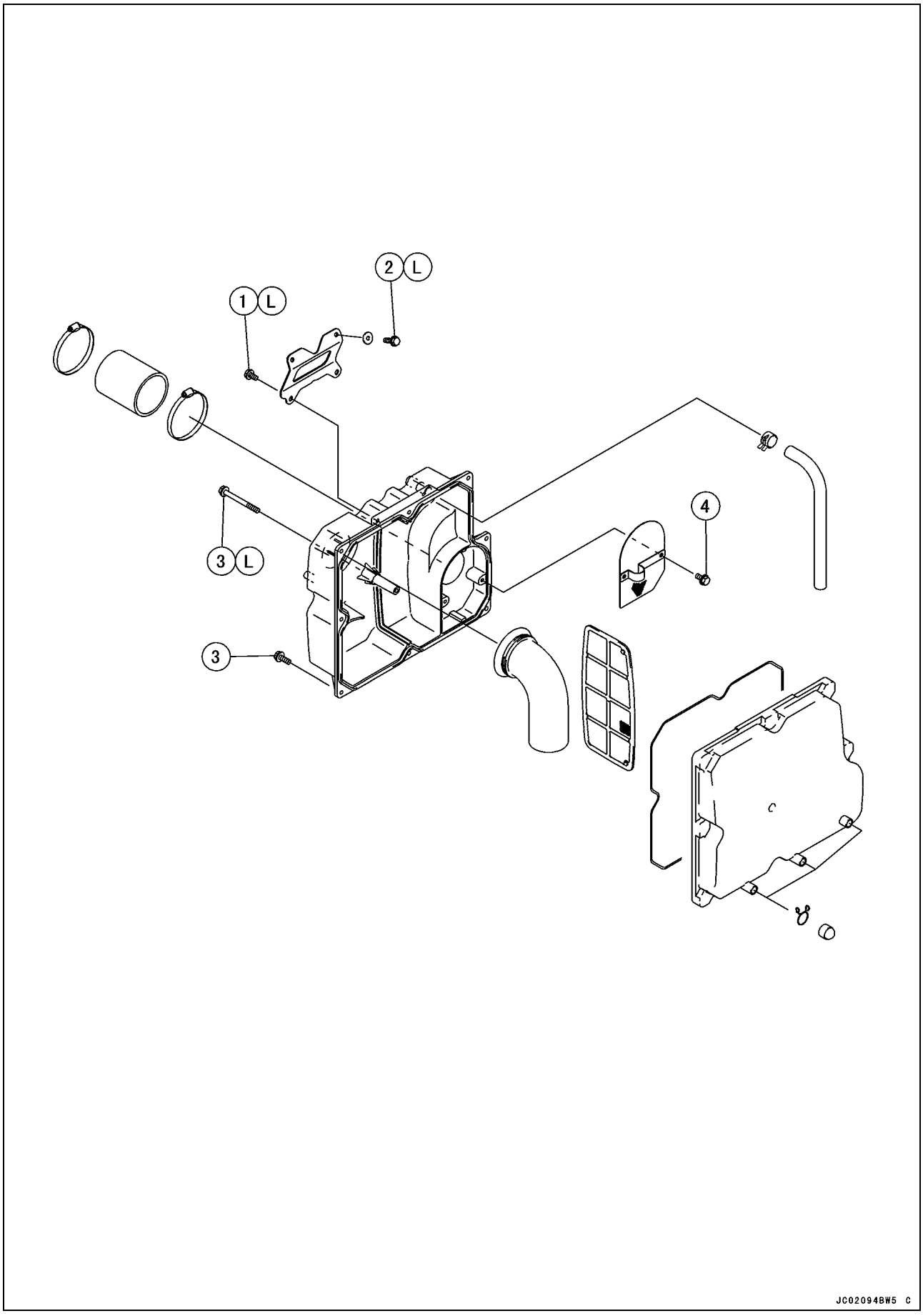


## Exploded View

| No. | Fastener | Torque | | | Remarks |
|---|---|---|---|---|---|
| | | N·m | kgf·m | ft·lb | |
| 1 | Fuel Filler Hose Clamp Screws | 2.9 | 0.30 | 26 in·lb | |
| 2 | Fuel Pump Rubber Holder Clamp Screws | 2.9 | 0.30 | 26 in·lb | |

3. AU and EUR Models
R: Replacement Parts

## Exploded View



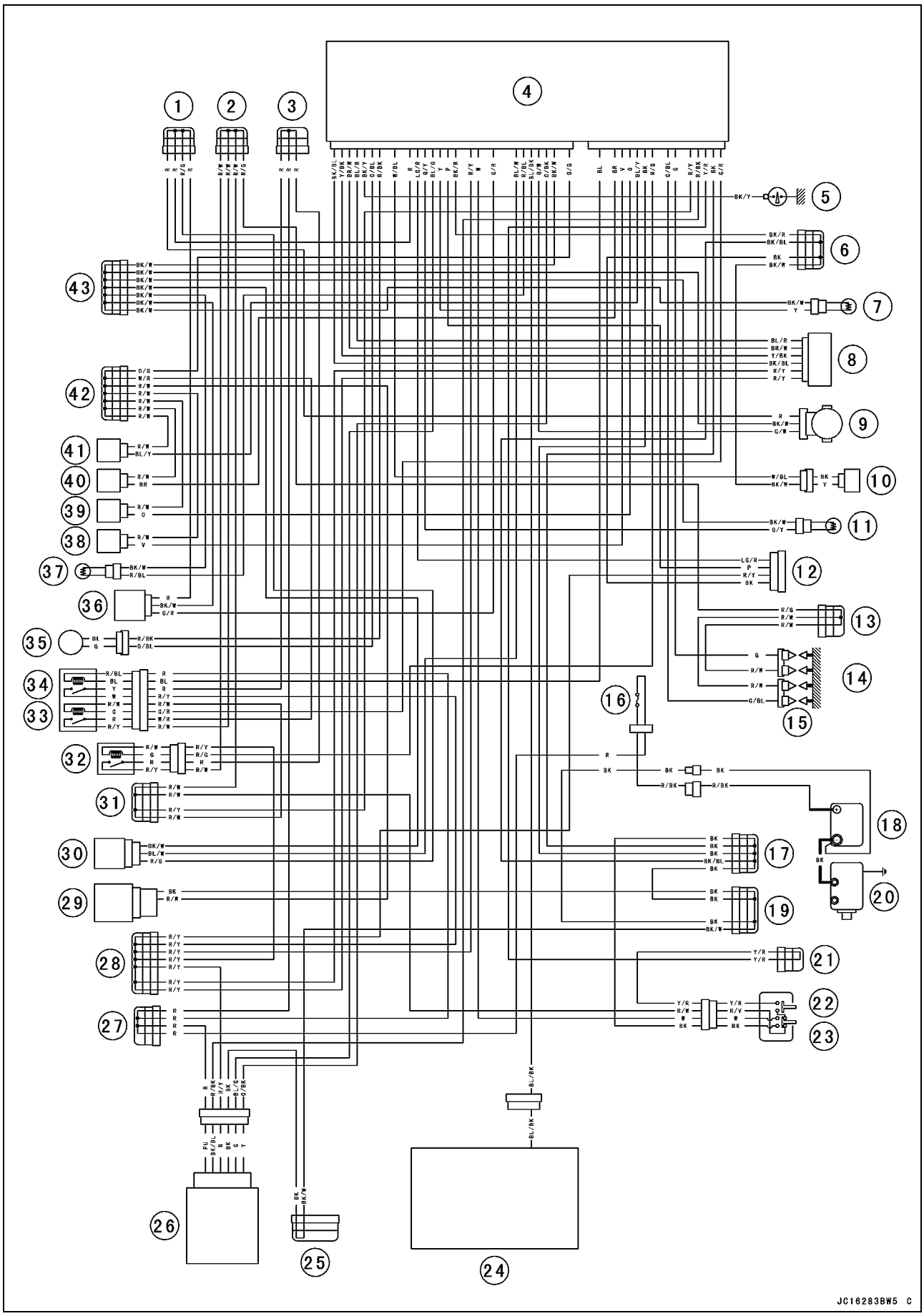
## Exploded View

| No. | Fastener | Torque | | | Remarks |
|---|---|---|---|---|---|
| | | N·m | kgf·m | ft·lb | |
| 1 | Air Box Mounting Bolts | 7.8 | 0.80 | 69 in·lb | L |
| 2 | Air Box Bracket Mounting Bolts | 8.8 | 0.90 | 78 in·lb | L |
| 3 | Air Box Assembly Bolts | 2.5 | 0.25 | 22 in·lb | L (1) |
| 4 | Air Box Flame Arrester Bolts | 2.5 | 0.25 | 22 in·lb | |

L: Apply a non-permanent locking agent.

## DFI System

### DFI System Wiring Diagram



## DFI System

**Part Names**

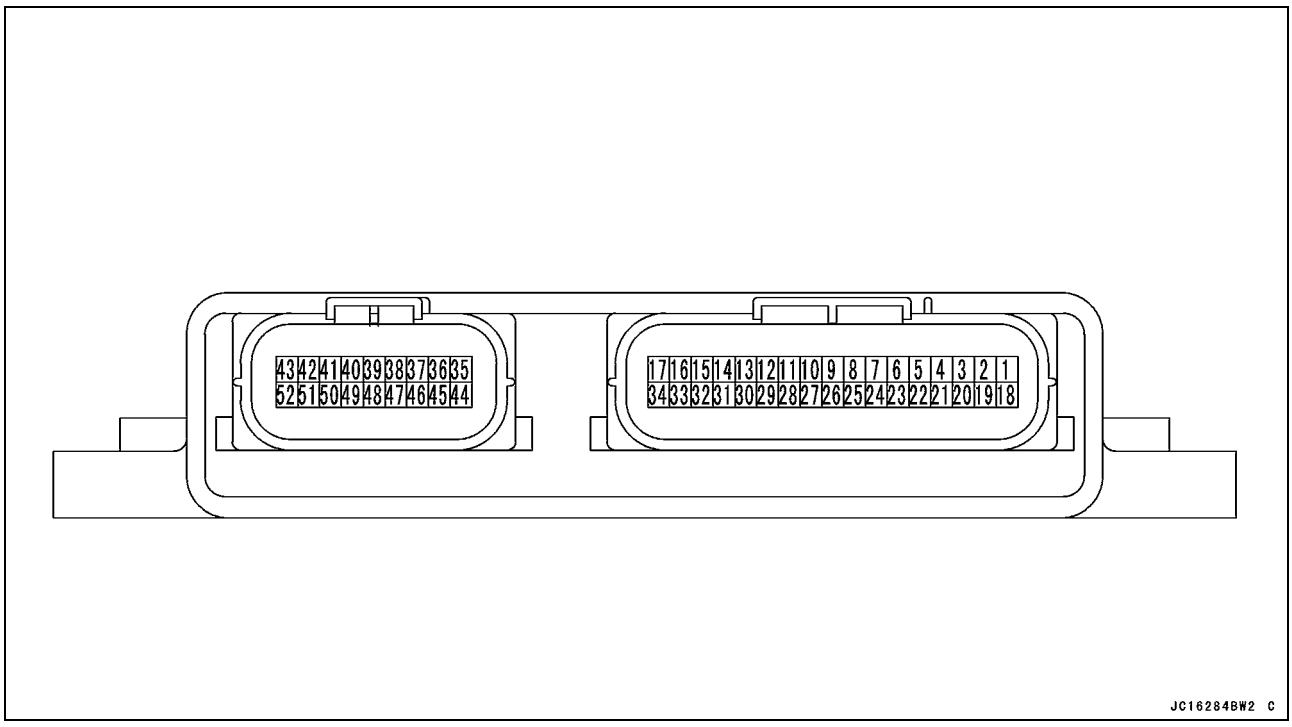
1. Joint Connector F (5 V)
2. Joint Connector D (12 V)
3. Joint Connector C (12 V)
4. ECU
5. Oil Pressure Switch
6. Joint Connector E (Ground)
7. Oil Temperature Sensor
8. ISC (Idle Speed Controller)
9. Throttle Position Sensor
10. Camshaft Position Sensor (Exhaust)
11. Water Temperature Sensor
12. Immobilizer/Kawasaki Diagnostic System Connector
13. Joint Connector M (12 V)
14. Spark Plugs
15. Ignition Coils
16. Main Fuse 20 A
17. Joint Connector Y (Ground)
18. Battery
19. Joint Connector S (Ground)
20. Starter Motor
21. Joint Connector X (12 V)
22. Engine Start Switch
23. Engine Stop Switch/Tether
24. Meter Unit
25. Joint Connector Q (Ground)
26. Ignition Switch (Immobilizer Amplifier)
27. Joint Connector P (12 V)
28. Joint Connector R (12 V)
29. Fuel Pump
30. Vehicle-down Sensor
31. Joint Connector T (12 V)
32. ECU Main Relay
33. Fuel Pump Relay
34. System Relay
35. Crankshaft Sensor
36. Intake Air Pressure Sensor
37. Intake Air Temperature Sensor
38. Injector #1
39. Injector #2
40. Injector #3
41. Injector #4
42. Joint Connector L (12 V)
43. Joint Connector B (Ground)

○Color Codes:

| | | |
|---|---|---|
| BK: Black | GY: Gray | PU: Purple |
| BL: Blue | LB: Light Blue | R: Red |
| BR: Brown | LG: Light Green | V: Violet |
| CH: Chocolate | O: Orange | W: White |
| DG: Dark Green | P: Pink | Y: Yellow |
| G: Green | | |

## DFI System

### Terminal Numbers of ECU Connectors



## DFI System

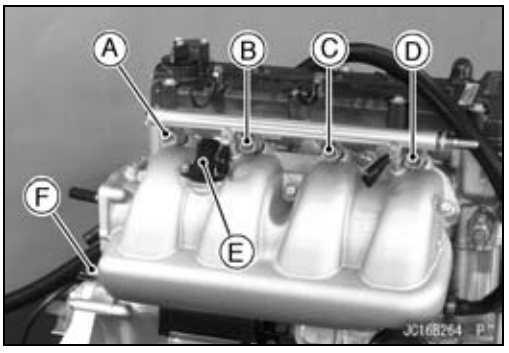
**Terminal Names**

1. ISC (Idle Speed Controller): BK/BL
2. ISC (Idle Speed Controller): Y/BK
3. Oil Pressure Switch: BK/Y
4. Unused
5. Crankshaft Sensor (–): O/BL
6. Unused
7. Camshaft Position Sensor: W/BL
8. Unused
9. Power Supply to Sensors: R
10. External Communication Line (Immobilizer System): LG/R
11. Water Temperature Sensor: G/Y
12. Immobilizer Amplifier: BL/G
13. Oil Temperature Sensor: Y
14. External Communication Line (*KDS): P
15. Ground for Control System: BK/R
16. Unused
17. Power Supply to ECU: R/Y
18. ISC (Idle Speed Controller): BR/W
19. ISC (Idle Speed Controller): BL/R
20. Engine Stop Switch: W
21. Steering Position Sensor: Y/W
22. Crankshaft Sensor (+): R/BK
23. Intake Air Pressure Sensor: G/R
24. Unused
25. Unused
26. Vehicle-down Sensor: BL/W
27. Unused
28. Intake Air Temperature Sensor: R/BL
29. ECU Communication Line (to Meter Unit): BL/BK
30. Throttle Position Sensor: G/W
31. Immobilizer Amplifier: O/BK
32. Ground for Sensors: BK/W
33. Unused
34. Battery Monitor Voltage Line: O/G
35. Unused
36. System Relay: BL
37. Unused
38. Fuel Injector #3: BR
39. Ground for Power: BK
40. ECU Main Relay: R/G
41. Unused
42. Fuel Injector #1: V
43. Ignition Coil #1, #4: G/BL
44. Main Switch: R/Y
45. Entry Switch (from Ignition Switch): R/BK
46. Start Switch: Y/R
47. Fuel Injector #4: BL/Y
48. Ground for Power: BK
49. Fuel Pump Relay: G/R
50. Ignition Coil #2, #3: G
51. Fuel Injector #2: O

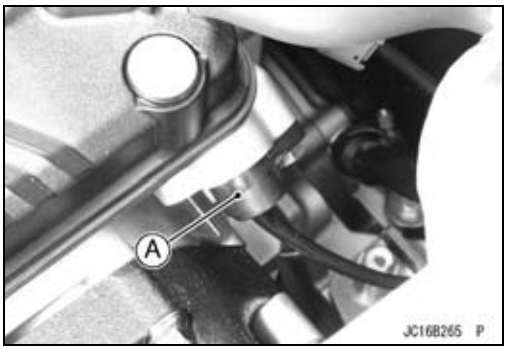
*: KDS (Kawasaki Diagnostic System)

## DFI Parts Location

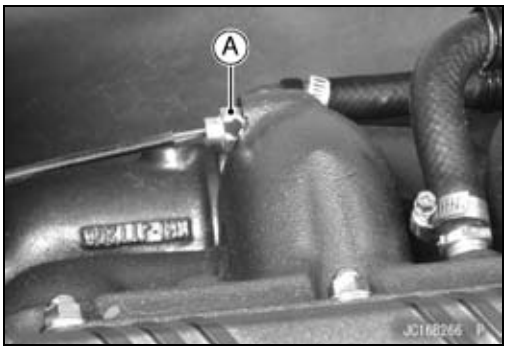
Fuel Injector #4 [A]
Fuel Injector #3 [B]
Fuel Injector #2 [C]
Fuel Injector #1 [D]
Intake Air Pressure Sensor [E]
Intake Air Temperature Sensor [F]



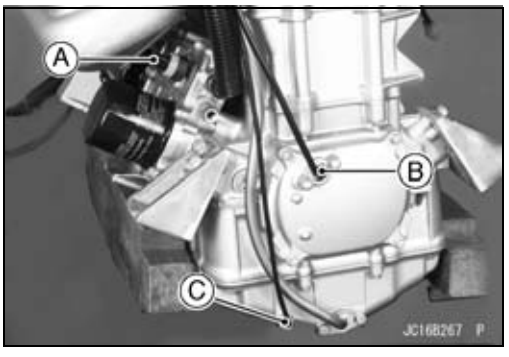

Camshaft Position Sensor [A]



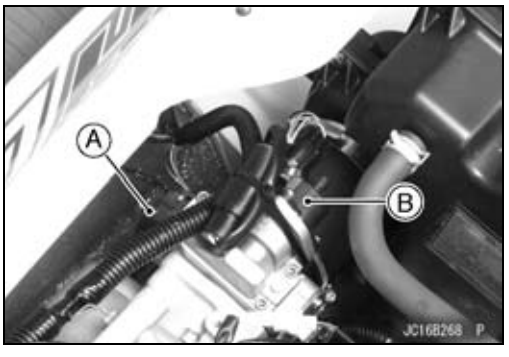

Water Temperature Sensor [A]




Oil Pressure Switch [A]
Crankshaft Sensor [B]
Oil Temperature Sensor [C]

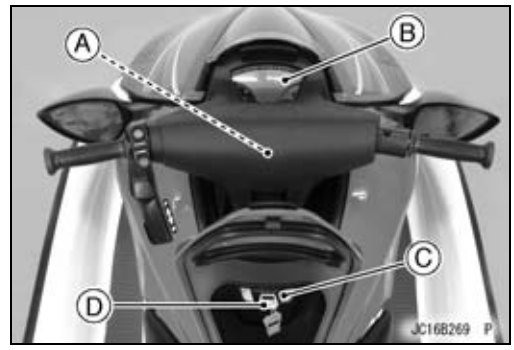



Throttle Position Sensor [A]
ISC (Idle Speed Controller) [B]

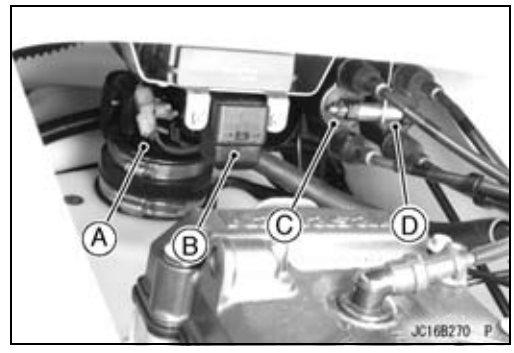


## DFI Parts Location

Buzzer [A]
Meter Unit [B]
Ignition Switch [C] (Immobilizer Amplifier)
Ignition Key [D] (Transponder)



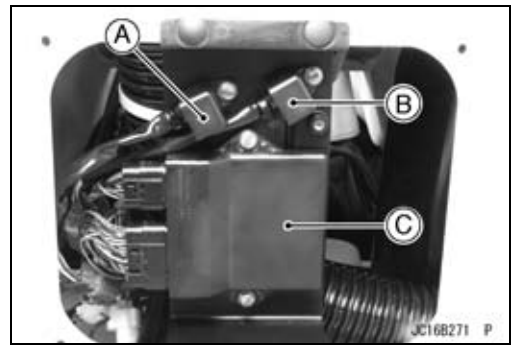

Fuel Pump [A]
Vehicle-down Sensor [B]
Ignition Coil #2, #3 [C]
Ignition Coil #1, #4 [D]




Relay Assy 2 [A] (ECU Main Relay)
Relay Assy 1 [B] (Fuel Pump Relay, System Relay)
ECU [C]

**NOTE**

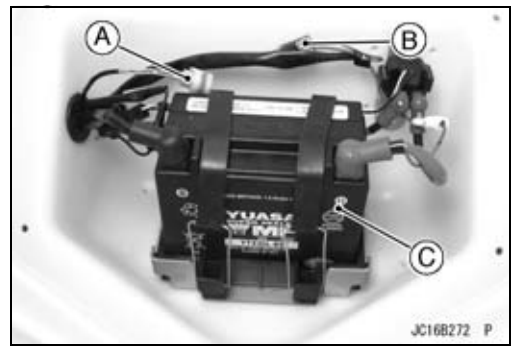
○*In this photo, the front access cover has been removed.*



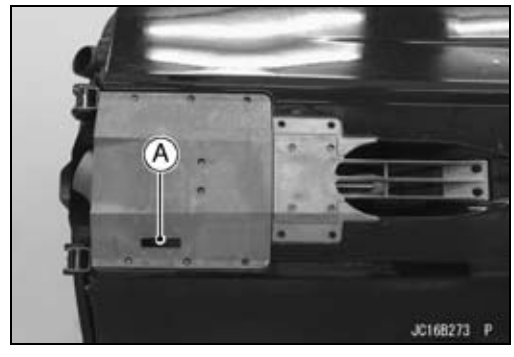

Immobilizer/Kawasaki Diagnostic System Connector [A]
Main Fuse 20 A [B]
Battery [C]

**NOTE**

○*In this photo, the battery cover has been removed.*




Speed Sensor [A]

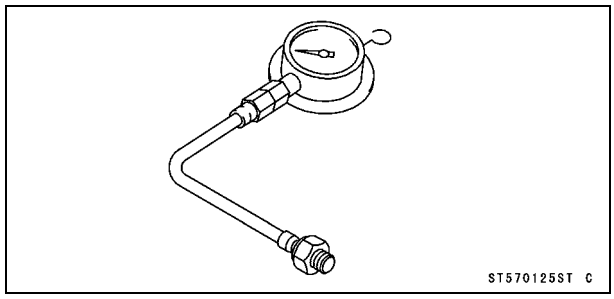


## Specifications

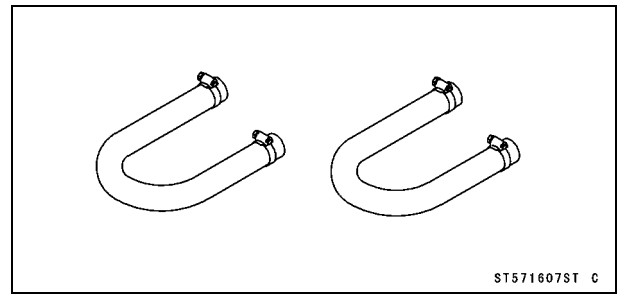
| Item | Standard |
|---|---|
| **Digital Fuel Injection System** | |
| Idle Speed | 1 300 ±100 r/min (rpm) - both in and out of water |
| Throttle Body Assy: | |
| Throttle Valve | Single type |
| Bore | $\phi$60 mm (2.36 in.) |
| ECU: | |
| Make | Mitsubishi Electric |
| Type | Digital memory type, with built in IC igniter, sealed with resin |
| Fuel Pressure (High Pressure Line) | 294 kPa (3.0 kgf/cm², 43 psi) with engine idling |
| Fuel Pump: | |
| Type | Impeller type |
| Discharge | 83 mL (2.8 US oz.) or more for 3 seconds |
| Fuel Injectors: | |
| Type | INP-281 |
| Nozzle Type | Fine atomizing type with 4 holes |
| Resistance | About 11.7 ~ 12.3 Ω at 20°C (68°F) |
| Throttle Position Sensor: | |
| Input Voltage | DC 4.75 ~ 5.25 V |
| Output Voltage | DC 1.08 ~ 1.18 V at idle throttle opening<br>DC 4.38 ~ 4.42 V at full throttle opening (for reference) |
| Resistance | 4 ~ 6 kΩ |
| Intake Air Pressure Sensor: | |
| Input Voltage | DC 4.75 ~ 5.25 V |
| Output Voltage | DC 3.75 ~ 4.25 V at standard atmospheric pressure (101.32 kPa, 76 cmHg) |
| Intake Air Temperature Sensor: | |
| Output Voltage | About DC 2.25 ~ 2.50 V at 20°C (68°F) |
| Resistance | 5.4 ~ 6.6 kΩ at 0°C (32°F)<br>0.29 ~ 0.39 kΩ at 80°C (176°F) |
| Water Temperature Sensor: | |
| Output Voltage | About DC 3.5 ~ 4.0 V at 20°C (68°F) |
| Vehicle-down Sensor: | |
| Input Voltage | DC 4.75 ~ 5.25 V |
| Output Voltage | With sensor tilted 110 ~ 130° or more right or left: DC 0.65 ~ 1.35 V<br>With sensor arrow mark pointed up: DC 3.55 ~ 4.45 V |
| Oil Temperature Sensor: | |
| Output Voltage | About DC 3.5 ~ 4.0 V at 20°C (68°F) |
| **Throttle Lever and Cable** | |
| Throttle Lever Free Play | About 2 mm (0.08 in.) |

## Special Tools and Sealant

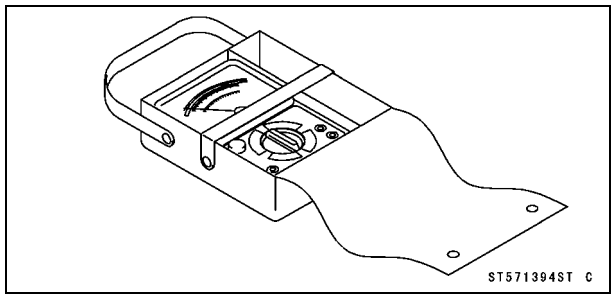
**Oil Pressure Gauge, 5 kgf/cm²:**
**57001-125**



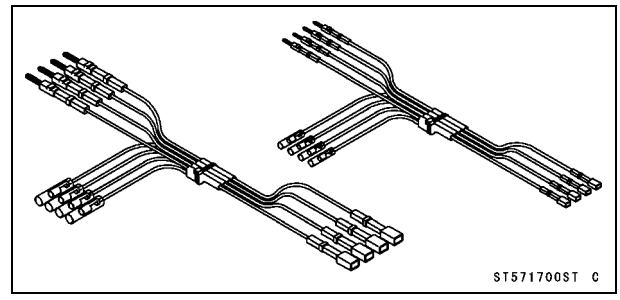

**Fuel Hose:**
**57001-1607**



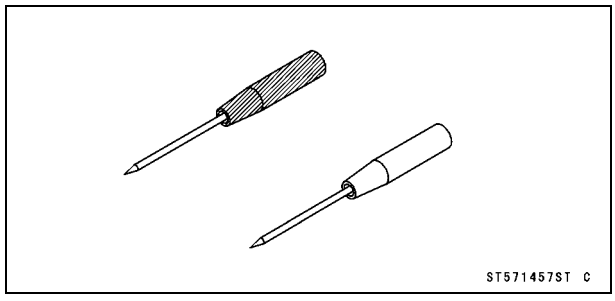

**Hand Tester:**
**57001-1394**



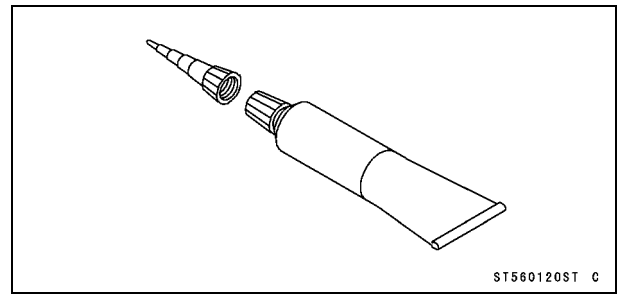

**Measuring Adapter:**
**57001-1700**



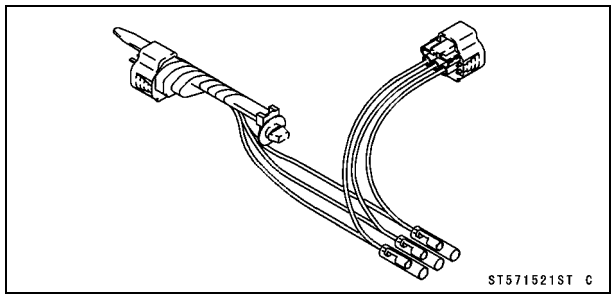

**Needle Adapter Set:**
**57001-1457**



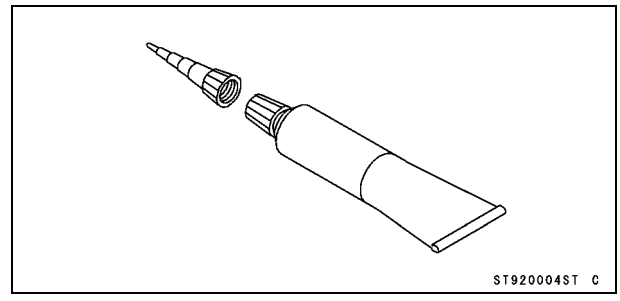

**Liquid Gasket, TB1211:**
**56019-120**



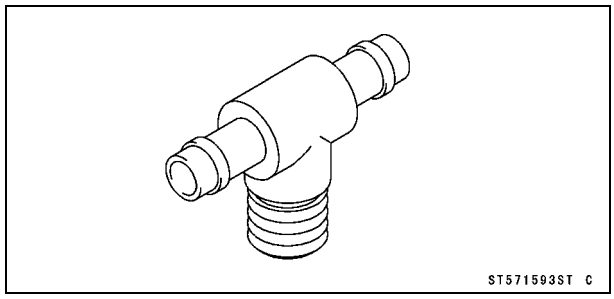

**Throttle Sensor Setting Adapter:**
**57001-1521**



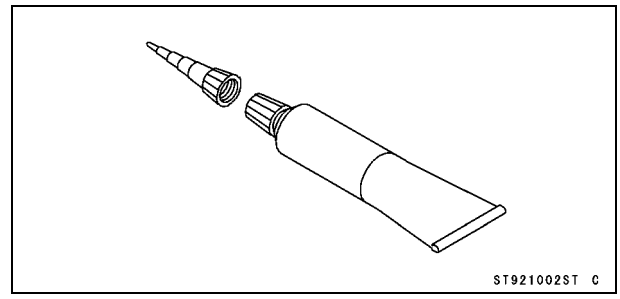

**Liquid Gasket, TB1211F:**
**92104-0004**




**Fuel Pressure Gauge Adapter:**
**57001-1593**




**Heat Transfer Grease, SCH-20:**
**92137-1002**

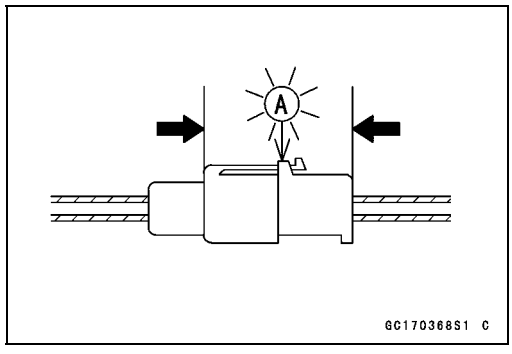


## DFI Servicing Precautions

There are a number of important precautions that should be followed servicing the DFI system.

- This DFI system is designed to be used with a 12 V sealed battery as its power source. Do not use any other battery except for a 12 V sealed battery as a power source.
- Do not reverse the battery cable connections. This will damage the ECU.
- To prevent damage to the DFI parts, do not disconnect the battery cables or any other electrical connections when the ignition switch is on or while the engine is running.
- Take care not to short the leads that are directly connected to the battery positive (+) terminal to the engine ground.
- When charging, remove the battery from the vehicle. This is to prevent ECU damage by excessive voltage.

- Whenever the DFI electrical connections are to be disconnected, first turn off the ignition switch, and disconnect the battery (–) terminal. Do not pull the lead, only the connector. Conversely, make sure that all the DFI electrical connections are firmly reconnected before starting the engine.
- Connect these connectors until they click [A].

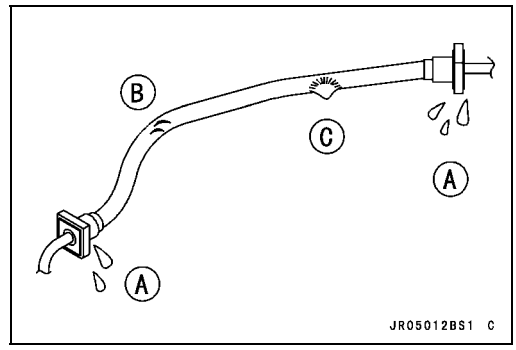



- Do not insert the ignition key in the ignition switch to turn it on while any of the DFI electrical connectors are disconnected. The ECU memorizes service codes.
- Do not spray water on the electrical parts, DFI parts, connectors, leads and wiring.
- If a transceiver is installed on the vehicle, make sure that the operation of the DFI system is not influenced by electric wave radiated from the antenna. Check operation of the system with the engine at idle. Locate the antenna as far as possible away from the ECU.
- When any fuel hose is disconnected, do not turn on the ignition switch. Otherwise, the fuel pump will operate and fuel will spout from the fuel hose.
- Do not operate the fuel pump if the pump is completely dry. This is to prevent pump seizure.
- Before removing the fuel system parts, blow the outer surfaces of these parts clean with compressed air.
- When any fuel hose is disconnected, fuel may spout out by residual pressure in the fuel line. Cover the hose joint with a piece of clean cloth to prevent fuel spillage.
- When installing the fuel hoses, avoid sharp bending, kinking, flattening or twisting, and run the fuel hoses with a minimum of bending so that the fuel flow will not be obstructed.
- Run the hoses according to Cable, Wire, and Hose Routing section in the Appendix chapter.
- To prevent corrosion and deposits in the fuel system, do not add to fuel any fuel antifreeze chemicals.

## DFI Servicing Precautions

○If the watercraft is not properly handled, the high pressure inside the fuel line can cause fuel to leak [A] or the hose to burst. Check the fuel hose.

★Replace the fuel hose if any fraying, cracks [B] or bulges [C] are noticed.




○To maintain the correct fuel/air mixture (F/A), there must be no intake air leaks in the DFI system. Be sure to install the oil filler cap [A] after filling the engine oil.

**Torque - Oil Filler Cap: Hand-tighten**

○When checking the DFI parts, do not run the engine for 15 seconds or more without auxiliary cooling (see Before Servicing section in the General Information chapter).

***NOTICE***

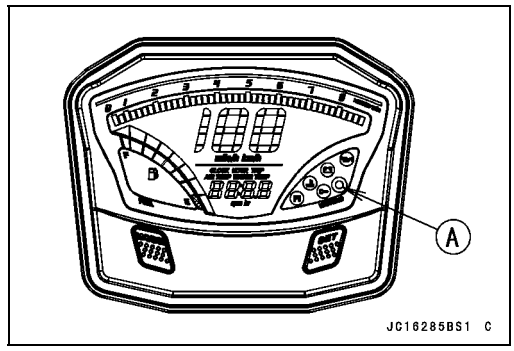
**Running the engine without auxiliary cooling for 15 seconds or more, even at idle speed, may damage the rubber components in the Exhaust System. Do not run the engine for more than 15 seconds without auxiliary cooling water.**

○Execute the auxiliary cooling securely in case that frequent engine running is required.

## Troubleshooting the DFI System

The red warning indicator light (LED) [A] is used for the following warnings.

Fuel Level
Low Battery Voltage
Engine Cooling Water Temperature
Engine Oil Pressure
Oil Temperature Sensor
Engine Oil Overheat
FI
Immobilizer




### *Outline*

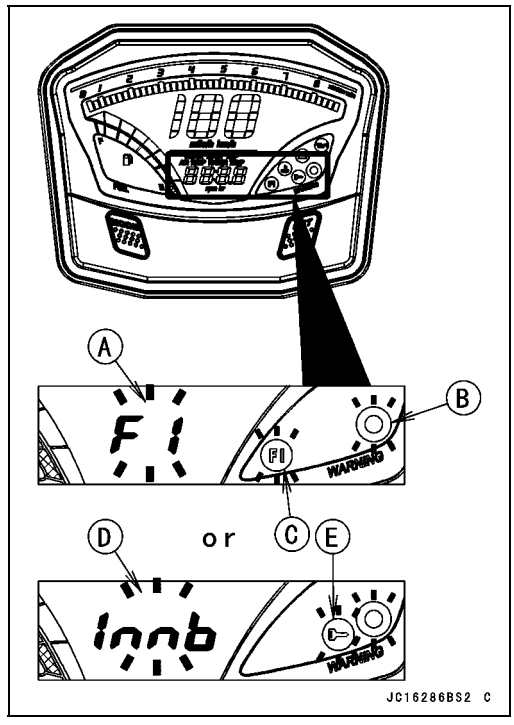
When a problem occurs with DFI system and immobilizer system, the warning indications to alert the rider are as follows. In addition, the condition of the problem is stored in the memory of the ECU.

**DFI System**

| "FI" Character [A]/Service Code Characters | Red Warning Indicator Light (LED) [B] | FI Warning Indicator [C] | Buzzer |
|---|---|---|---|
| Blinks | Goes on | Blinks | Sounds |

**Immobilizer System**

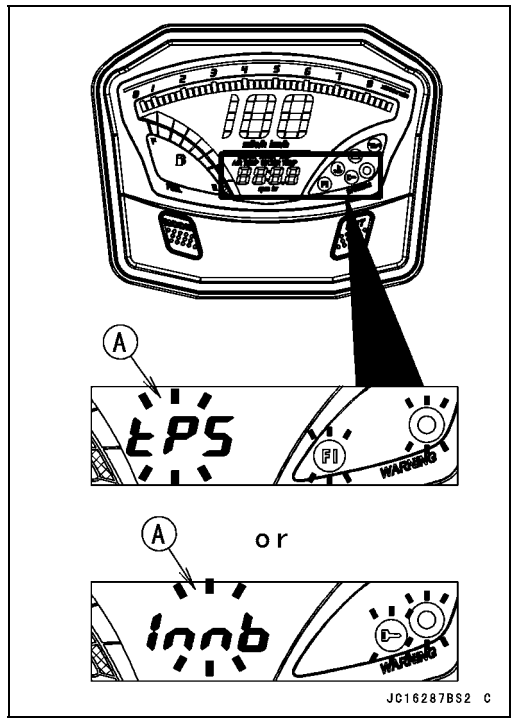
| Service Code Characters [D] | Red Warning Indicator Light (LED) | Immobilizer Warning Indicator [E] | Buzzer |
|---|---|---|---|
| Blinks | Blinks | Blinks | Sounds |




With the engine stopped and turned in the self-diagnosis mode, the service code characters [A] are displayed on the LCD (Liquid Crystal Display).

If the problem is with the following parts, the ECU can not recognize these problem. Therefore, the "FI" character, red warning indicator light (LED), FI and/or immobilizer warning indicators do not go on and/or blink, the buzzer does not sound, and service code characters are not displayed.

LCD for Meter Unit
Fuel Pump
Fuel Injectors
Ignition Coil Secondary Wiring and Ground Wiring
ECU Power Source Wiring and Ground Wiring

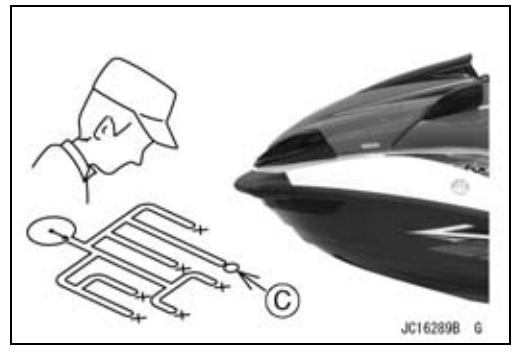


## Troubleshooting the DFI System

When the service code character [A] is displayed, for first ask the rider about the conditions [B] of trouble, and then start to determine the cause [C] of problem.

As a pre-diagnosis inspection, check the ECU for ground and power supply, the fuel line for no fuel leaks, and for correct pressure. The pre-diagnosis items are not indicated by the “FI” character, red warning indicator light (LED), FI warning indicator and buzzer sound.

Don’t rely solely on the DFI self-diagnosis function, use common sense.




Even when the DFI system is operating normally, the red warning indicator light (LED) may go on, “FI” character and FI warning indicator may blink, and the buzzer may sound under strong electrical interference. Additional measures are not required. Remove the ignition key to stop the character, indicator light, indicator, and buzzer sound.

If the red warning indicator light (LED) still go on, “FI” character and FI warning indicator blink and buzzer sounds when the vehicle is brought in for repair, check the service code characters.

When the repair has been done, all warning indications go off. But the service code characters stored in memory of the ECU are not erased to preserve the problem history. The problem history can be referred using the KDS (Kawasaki Diagnostic System) when solving unstable problems.

When the watercraft is down, the vehicle-down sensor operates and the ECU shuts off the fuel pump relay, fuel injectors and ignition system. To start the engine again, raise the watercraft, remove the ignition key, and then ON.

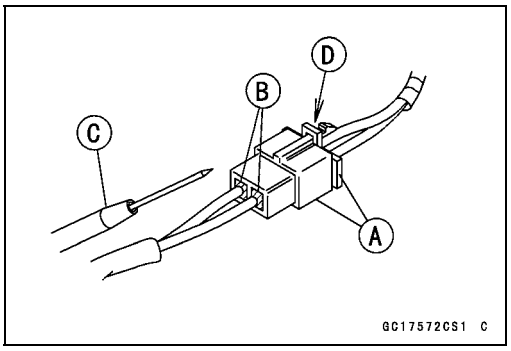
Much of the DFI system troubleshooting work consists of confirming continuity of the wiring. The DFI parts are assembled and adjusted with precision, and it is impossible to disassemble or repair them.

## Troubleshooting the DFI System

- When checking the DFI parts, use a digital meter which can be read two decimal place voltage or resistance.

○The DFI part connectors [A] have seals [B], including the ECU. When measuring the input or output voltage with the connector joined, use the needle adapter set [C]. Insert the needle adapter inside the seal until the needle adapter reaches the terminal.

**Special Tool - Needle Adapter Set: 57001-1457**




***NOTICE***

**If the needle adapter is inserted at an angle it may create a short-circuit between the terminals and damage the electrical system. To avoid a short circuit, insert the needle adapter straight along the terminal in the connector.**

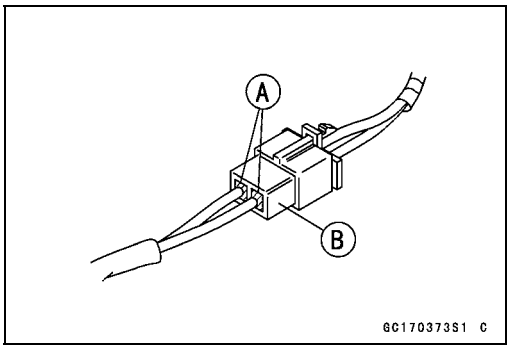
- Make sure that measuring points are correct in the connector, noting the position of the lock [D] and the lead color before measurement. Do not reverse connections of a digital meter.
- Be careful not to short-circuit the leads of the DFI or electrical system parts by contact between adapters.
- Insert the ignition key in the ignition switch to turn it on and measure the voltage with the connector joined.

***NOTICE***

**Incorrect, reverse connection or short circuit by needle adapters could damage the DFI or electrical system parts. To avoid DFI or electrical damage, be sure the needle adapters are inserted correctly.**

○After measurement, remove the needle adapters and apply silicone sealant to the seals [A] of the connector [B] for waterproofing.

**Sealant - Liquid Gasket, TB1211: 56019-120**




- Always check battery condition before replacing the DFI parts. A fully charged battery is a must for conducting accurate tests of the DFI system.
- Trouble may involve one or in some cases all items. Never replace a defective part without determining what CAUSED the problem. If the problem was caused by some other item or items, they too must be repaired or replaced, or the new replacement part will soon fail again.
- Measure coil winding resistance when the DFI part is cold (at room temperature).
- Make sure all connectors in the circuit are clean and tight, and examine wires for signs of burning, fraying, short, etc. Deteriorated wires and bad connections can cause reappearance of problems and unstable operation of the DFI system.

★If any wiring is deteriorated, replace the wiring.

## Troubleshooting the DFI System

● Pull each connector [A] apart and inspect it for corrosion, dirt, and damage.

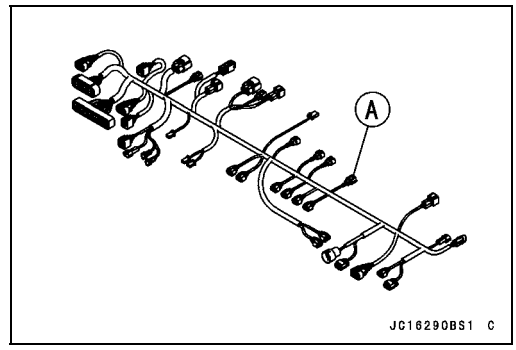
★If the connector is corroded or dirty, clean it carefully. If it is damaged, replace it. Connect the connectors securely.

● Check the wiring for continuity.

○Use the wiring diagram to find the ends of the lead which is suspected of being a problem.

○Connect the hand tester between the ends of the leads.

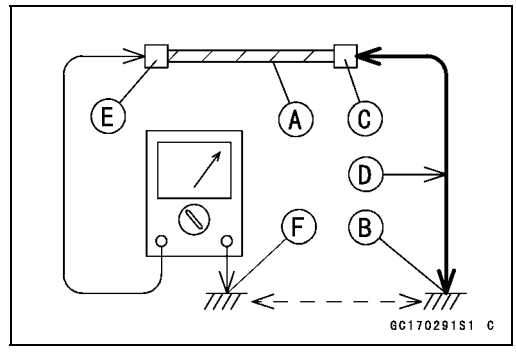
**Special Tool - Hand Tester: 57001-1394**



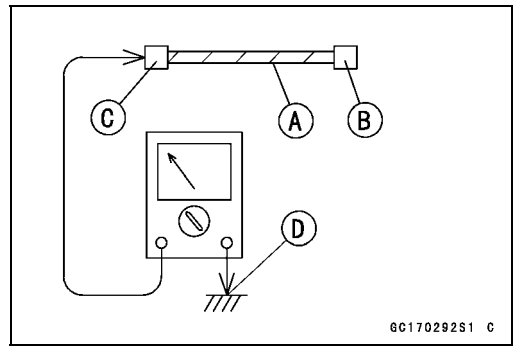

○Set the tester to the × 1 Ω range, and read the tester.

★If the tester does not read 0 Ω, the lead is defective. Replace the lead or the main harness.

○If both ends of a harness [A] are far apart, ground [B] the one end [C], using a jumper lead [D] and check the continuity between the end [E] and the ground [F]. This enables to check a long harness for continuity. If the harness is open, repair or replace the harness.




○When checking a harness [A] for short circuit, open one end [B] and check the continuity between the other end [C] and ground [D]. If there is continuity, the harness has a short circuit to ground, and it must be repaired or replaced.




● Narrow down suspicious locations by repeating the continuity tests from the ECU connectors.

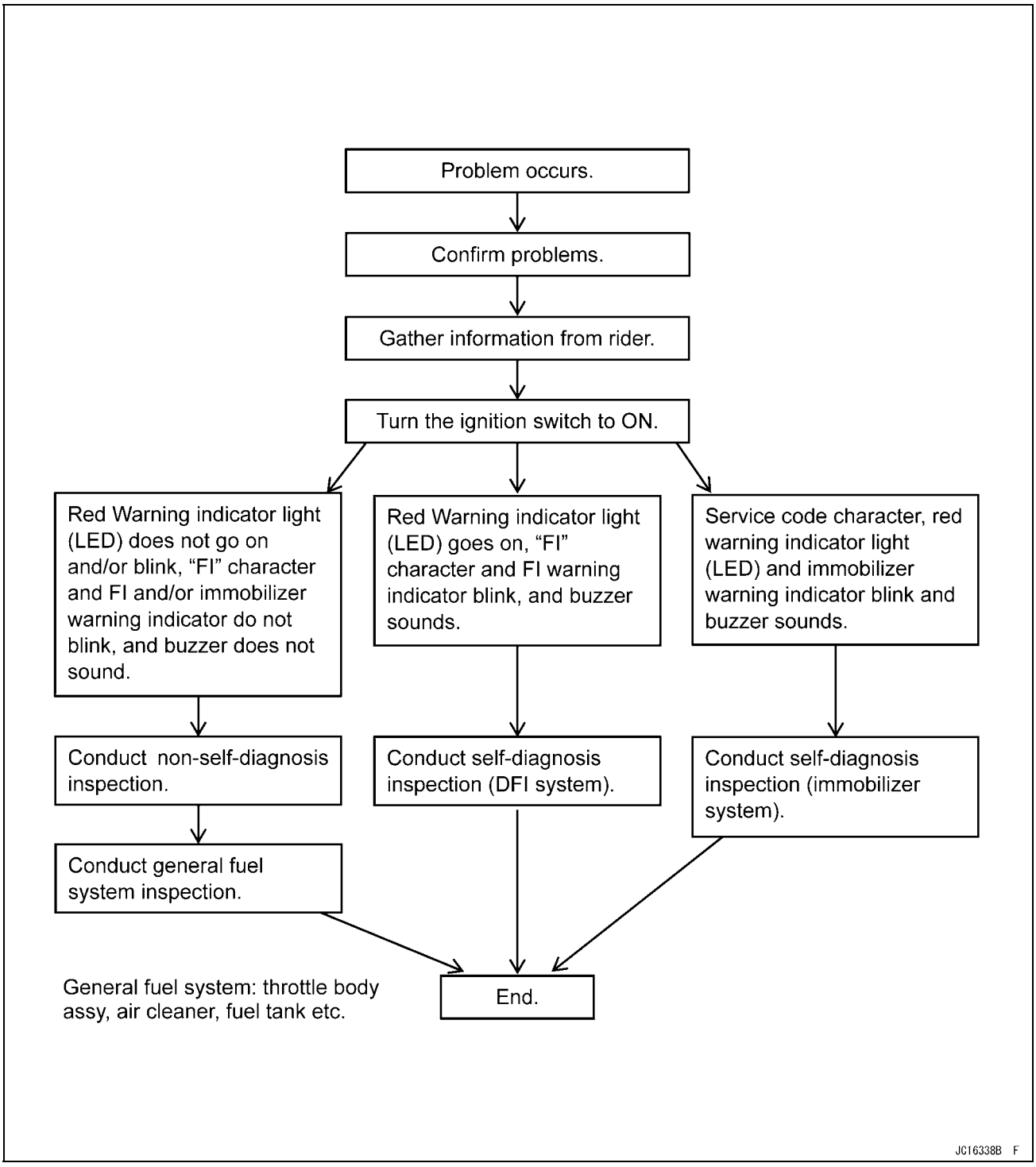
★If no abnormality is found in the wiring or connectors, the DFI parts are the next likely suspects. Check the part, starting with input and output voltages. However, there is no way to check the ECU itself.

★If an abnormality is found, replace the affected DFI part.

★If no abnormality is found in the wiring, connectors, and DFI parts, replace the ECU.

## Troubleshooting the DFI System

### DFI Diagnosis Flow Chart


Problem occurs.
Confirm problems.
Gather information from rider.
Turn the ignition switch to ON.
Red Warning indicator light (LED) does not go on and/or blink, “FI” character and FI and/or immobilizer warning indicator do not blink, and buzzer does not sound.
Red Warning indicator light (LED) goes on, “FI” character and FI warning indicator blink, and buzzer sounds.
Service code character, red warning indicator light (LED) and immobilizer warning indicator blink and buzzer sounds.
Conduct non-self-diagnosis inspection.
Conduct self-diagnosis inspection (DFI system).
Conduct self-diagnosis inspection (immobilizer system).
Conduct general fuel system inspection.
General fuel system: throttle body assy, air cleaner, fuel tank etc.
End.
JC16338B F

## Inquiries to Rider

○Each rider reacts to problems in different ways, so it is important to confirm what kind of symptoms the rider has encountered.

○Try to find out exactly what problem occurred under exactly what conditions by asking the rider; knowing this information may help you reproduce the problem.

○The following sample diagnosis sheet will help prevent you from overlooking any areas, and will help you decide if it is a DFI system problem, or a general engine problem.

## Troubleshooting the DFI System

### Sample Diagnosis Sheet

| | | |
|---|---|---|
| **Rider name:** | **Registration No. (license plate No.):** | **Year of initial registration:** |
| **Model:** | **Engine No.:** | **Hull No.:** |
| **Date problem occurred:** | | **Mileage:** |
| **Environment when problem occurred.** | | |
| Weather | ☐ fine, ☐ cloudy, ☐ rain, ☐ snow, ☐ always, ☐ other: | |
| Temperature | ☐ hot, ☐ warm, ☐ cold, ☐ very cold, ☐ always, ☐ other: | |
| Problem frequency | ☐ chronic, ☐ often, ☐once | |
| Altitude | ☐ normal, ☐ high (about 1 000 m or more) | |
| **Watercraft conditions when problem occurred.** | | |
| "FI" character, red warning indicator light (LED), FI/immobilizer warning indicator | ☐ Goes on immediately after ignition switch ON, and goes off after 2 ~ 3 seconds (normal). | |
| | ☐ Goes on immediately after ignition switch ON, and the "FI" character and FI warning indicator on the LCD starts blinking (DFI system problem). | |
| | ☐ Start blinks immediately after ignition switch ON, and the service code character and immobilizer warning indicator on the LCD starts blinking (immobilizer system problem). | |
| | ☐ Does not go on or blink after ignition switch ON. | |
| | ☐ light up (ECU or meter unit replace). | |
| Starting difficulty | ☐ starter motor not rotating. | |
| | ☐ starter motor rotating but engine does not turn over. | |
| | ☐ starter motor and engine do not turn over. | |
| | ☐ no fuel flow (☐ no fuel in tank, ☐ no fuel pump sound). | |
| | ☐ no spark. | |
| | ☐ other: | |
| Engine stalls | ☐ right after starting. | |
| | ☐ when opening throttle lever. | |
| | ☐ when closing throttle lever. | |
| | ☐ when moving off. | |
| | ☐ when stopping the watercraft. | |
| | ☐ when cruising. | |
| | ☐ other: | |
| Poor running at low speed | ☐ very low idle speed, ☐ very high idle speed, ☐ rough idle speed. | |
| | ☐ battery voltage is low (charge the battery). | |
| | ☐ spark plug loose (tighten it). | |
| | ☐ spark plug dirty, broken, or gap maladjusted (remedy it). | |
| | ☐ backfiring. | |
| | ☐ afterfiring. | |
| | ☐ hesitation when acceleration. | |
| | ☐ engine oil viscosity too high. | |
| | ☐ engine overheating. | |
| | ☐ other: | |

## Troubleshooting the DFI System

| | |
|---|---|
| Poor running or no power at high speed | ☐ spark plug loose (tighten it). |
| | ☐ spark plug dirty, broken, or gap maladjusted (remedy it). |
| | ☐ spark plug incorrect (replace it). |
| | ☐ knocking (fuel poor quality or incorrect, → use high-octane gasoline). |
| | ☐ engine overheating. |
| | ☐ engine oil level too high. |
| | ☐ engine oil viscosity too high. |
| | ☐ other: |

## DFI System Troubleshooting Guide

**NOTE**

○*This is not an exhaustive list, giving every possible cause for each problem listed. It is meant simply as a rough guide to assist the troubleshooting for some of the more common difficulties in DFI system.*

○*The ECU may be involved in the DFI electrical and ignition system troubles. If these parts and circuits are checked out good, be sure to check the ECU for ground and power supply. If the ground and power supply are checked good, replace the ECU.*

### Engine Won't Turn Over

| Symptoms or Possible Causes | Actions |
|---|---|
| Immobilizer system trouble | Inspect (see chapter 14). |
| Vehicle-down sensor operated | Turn ignition switch OFF (see chapter 3). |
| Vehicle-down sensor trouble | Inspect (see chapter 3). |
| Crankshaft sensor trouble | Inspect (see chapter 14). |
| Ignition coil shorted or not in good contact | Inspect or reinstall (see chapter 14). |
| Ignition coil trouble | Inspect (see chapter 14). |
| Spark plug dirty, broken or gap maladjusted | Inspect and replace (see chapter 2). |
| Spark plug incorrect | Replace it with the correct plug (see chapter 2). |
| ECU ground and power supply trouble | Inspect (see chapter 3). |
| ECU trouble | Inspect (see chapter 3). |
| No or little fuel in tank | Supply fuel (see Owner's Manual). |
| Fuel injector trouble | Inspect and replace (see chapter 3). |
| Fuel pump not operating | Inspect (see chapter 3). |
| Fuel pump relay trouble | Inspect and replace (see chapter 3). |
| Fuel filter or pump screen clogged | Inspect and replace fuel pump (see chapter 3). |
| Fuel pressure regulator trouble | Inspect fuel pressure and replace fuel pump (see chapter 3). |
| Fuel line clogged | Inspect and repair (see chapter 3). |

### Poor Running at Low Speed

| Symptoms or Possible Causes | Actions |
|---|---|
| **Spark weak:** | |
| Ignition coil shorted or not in good contact | Inspect or reinstall (see chapter 14). |
| Ignition coil trouble | Inspect (see chapter 14). |
| Spark plug dirty, broken or gap maladjusted | Inspect and replace (see chapter 2). |
| Spark plug incorrect | Replace it with the correct plug (see chapter 2). |
| ECU trouble | Inspect (see chapter 3). |
| **Fuel/air mixture incorrect:** | |
| Little fuel in tank | Supply fuel (see Owner's Manual). |
| Air cleaner clogged, poorly sealed, or missing | Replace element or inspect sealing (see chapter 3). |
| Intake manifold loose | Reinstall (see chapter 3). |
| Throttle body assy loose | Reinstall (see chapter 3). |
| Throttle body assy gasket damage | Replace (see chapter 3). |
| Fuel injector O-ring damage | Replace (see chapter 3). |
| Fuel filter or pump screen clogged | Inspect and replace fuel pump (see chapter 3). |

## DFI System Troubleshooting Guide

| Symptoms or Possible Causes | Actions |
|---|---|
| Fuel pressure regulator trouble | Inspect fuel pressure and replace fuel pump (see chapter 3). |
| Fuel line clogged | Inspect and repair (see chapter 3). |
| Intake air pressure sensor trouble | Inspect (see chapter 3). |
| Water temperature sensor trouble | Inspect (see chapter 3). |
| Intake air temperature sensor trouble | Inspect (see chapter 3). |
| Throttle position sensor trouble | Inspect (see chapter 3). |
| **Unstable (rough) idling:** | |
| Fuel pressure too low or too high | Inspect (see chapter 3). |
| Fuel injector trouble | Inspect (see chapter 3). |
| Throttle position sensor trouble | Inspect (see chapter 3). |
| Intake air pressure sensor trouble | Inspect (see chapter 3). |
| Water temperature sensor trouble | Inspect (see chapter 3). |
| Intake air temperature sensor trouble | Inspect (see chapter 3). |
| **Engine stalls easily:** | |
| Spark plug dirty, broken or gap maladjusted | Inspect and replace (see chapter 2). |
| Ignition coil trouble | Inspect (see chapter 14). |
| Throttle position sensor trouble | Inspect (see chapter 3). |
| Intake air pressure sensor trouble | Inspect (see chapter 3). |
| Water temperature sensor trouble | Inspect (see chapter 3). |
| Intake air temperature sensor trouble | Inspect (see chapter 3). |
| Fuel pump trouble | Inspect (see chapter 3). |
| Fuel injector trouble | Inspect (see chapter 3). |
| Fuel pressure too low or too high | Inspect (see chapter 3). |
| Fuel pressure regulator trouble | Inspect fuel pressure and replace fuel pump (see chapter 3). |
| Fuel line clogged | Inspect and repair (see chapter 3). |
| **Poor acceleration:** | |
| Fuel pressure too low | Inspect (see chapter 3). |
| Water or foreign matter in fuel | Change fuel. Inspect and clean fuel system (see chapter 3). |
| Fuel filter or pump screen clogged | Inspect and replace fuel pump (see chapter 3). |
| Fuel pump trouble | Inspect (see chapter 3). |
| Fuel injector trouble | Inspect (see chapter 3). |
| Throttle position sensor trouble | Inspect (see chapter 3). |
| Intake air pressure sensor trouble | Inspect (see chapter 3). |
| Water temperature sensor trouble | Inspect (see chapter 3). |
| Intake air temperature sensor trouble | Inspect (see chapter 3). |
| Spark plug dirty, broken or gap maladjusted | Inspect and replace (see chapter 2). |
| Ignition coil trouble | Inspect (see chapter 14). |
| **Stumble:** | |
| Fuel pressure too low | Inspect (see chapter 3). |
| Fuel injector trouble | Inspect (see chapter 3). |
| Throttle position sensor trouble | Inspect (see chapter 3). |
| Intake air pressure sensor trouble | Inspect (see chapter 3). |

## DFI System Troubleshooting Guide

| Symptoms or Possible Causes | Actions |
|---|---|
| Water temperature sensor trouble | Inspect (see chapter 3). |
| Intake air temperature sensor trouble | Inspect (see chapter 3). |
| **Surge:** | |
| Unstable fuel pressure | Fuel pressure regulator trouble (Inspect and replace fuel pump) or kinked fuel line (Inspect and replace fuel pump) (see chapter 3). |
| Fuel injector trouble | Inspect (see chapter 3). |
| Water temperature sensor trouble | Inspect (see chapter 3). |
| **Backfiring when deceleration:** | |
| Spark plug dirty, broken or gap maladjusted | Inspect and replace (see chapter 2). |
| Fuel pressure too low | Inspect (see chapter 3). |
| Fuel pump trouble | Inspect (see chapter 3). |
| Throttle position sensor trouble | Inspect (see chapter 3). |
| Intake air pressure sensor trouble | Inspect (see chapter 3). |
| Water temperature sensor trouble | Inspect (see chapter 3). |
| Intake air temperature sensor trouble | Inspect (see chapter 3). |
| **After fire:** | |
| Spark plug burned or gap maladjusted | Replace (see chapter 2). |
| Fuel injector trouble | Inspect (see chapter 3). |
| Intake air pressure sensor trouble | Inspect (see chapter 3). |
| Water temperature sensor trouble | Inspect (see chapter 3). |
| Intake air temperature sensor trouble | Inspect (see chapter 3). |
| **Other:** | |
| Intermittent any DFI fault and its recovery | Check that DFI connectors are clean and tight, and examine leads for signs of burning or fraying (see chapter 3). |

## Poor Running or No Power at High Speed

| Symptoms or Possible Causes | Actions |
|---|---|
| **Firing incorrect:** | |
| Ignition coil shorted or not in good contact | Inspect or reinstall (see chapter 14). |
| Ignition coil trouble | Inspect (see chapter 14). |
| Spark plug dirty, broken or gap maladjusted | Inspect and replace (see chapter 2). |
| Spark plug incorrect | Replace it with the correct plug (see chapter 2). |
| ECU trouble | Inspect (see chapter 3). |
| **Fuel/air mixture incorrect:** | |
| Air cleaner clogged, poorly sealed, or missing | Replace element or inspect sealing (see chapter 3). |
| Intake manifold loose | Reinstall (see chapter 3). |
| Throttle body assy loose | Reinstall (see chapter 3). |
| Throttle body assy gasket damage | Replace (see chapter 3). |
| Water or foreign matter in fuel | Change fuel. Inspect and clean fuel system (see chapter 3). |
| Fuel injector O-ring damage | Replace (see chapter 3). |
| Fuel injector clogged | Inspect and repair (see chapter 3). |

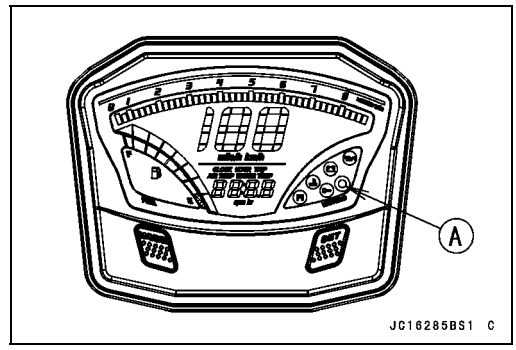
## DFI System Troubleshooting Guide

| Symptoms or Possible Causes | Actions |
|---|---|
| Fuel line clogged | Inspect and repair (see chapter 3). |
| Fuel pump operates intermittently. | Fuel pump bearings may wear. Replace the fuel pump (see chapter 3). |
| Fuel pump trouble | Inspect (see chapter 3). |
| Intake air pressure sensor trouble | Inspect (see chapter 3). |
| Water temperature sensor trouble | Inspect (see chapter 3). |
| Intake air temperature sensor trouble | Inspect (see chapter 3). |
| Throttle position sensor trouble | Inspect (see chapter 3). |
| **Knocking:** | |
| Fuel poor quality or incorrect | Fuel change (Use the gasoline recommended in the Owner's Manual). |
| Spark plug incorrect | Replace it with the correct plug (see chapter 2). |
| Ignition coil trouble | Inspect (see chapter 14). |
| ECU trouble | Inspect (see chapter 3). |
| Intake air pressure sensor trouble | Inspect (see chapter 3). |
| Water temperature sensor trouble | Inspect (see chapter 3). |
| Intake air temperature sensor trouble | Inspect (see chapter 3). |
| **Miscellaneous:** | |
| Throttle valve will not fully open | Inspect throttle cable and lever linkage (see chapter 3). |
| Engine overheating - Water temperature sensor or crankshaft sensor trouble | (see Overheating of Troubleshooting Guide in chapter 16) |

## Self-Diagnosis

The red warning indicator light (LED) [A] is used for the following warnings.

Fuel Level
Low Battery Voltage
Engine Cooling Water Temperature
Engine Oil Pressure
Oil Temperature Sensor
Engine Oil Overheat
FI
Immobilizer




## Self-diagnosis Outline

The self-diagnosis system has two modes and can be switched to another mode by operating the meter unit.

**User Mode**

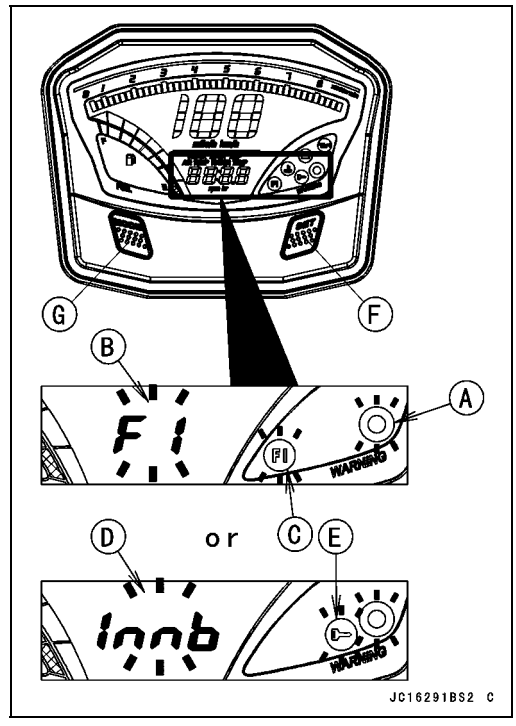
The ECU notifies the rider of troubles in DFI system and ignition system by turning on the red warning indicator light (LED) [A], by blinking the “FI” character [B] and FI warning indicator [C], and sounding the buzzer.

The ECU notifies the rider of troubles in the immobilizer system by blinking the service code character [D], red warning indicator light (LED) and immobilizer warning indicator [E], and sounding the buzzer.

When DFI, ignition and immobilizer system parts are faulty, the ECU initiates fail-safe function. In case of serious troubles ECU stops the injection/ignition/starter motor operation.

**NOTE**

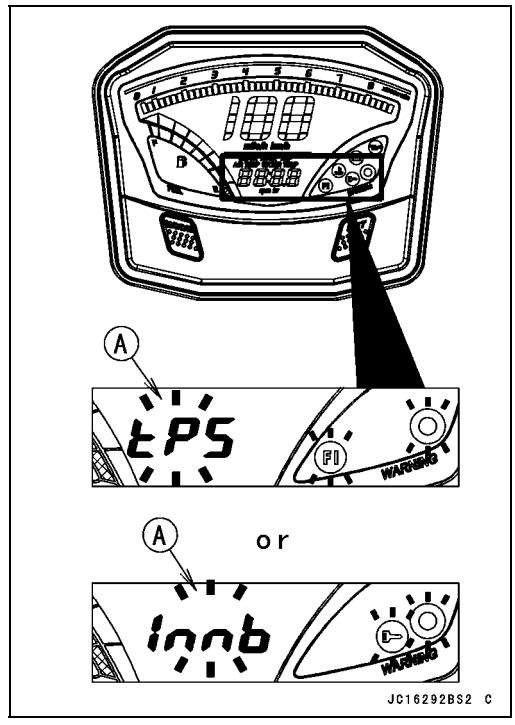
○*The buzzer sound can be stopped by pushing either “SET” [F] or “MODE” [G] button.*



## Self-Diagnosis

### Dealer Mode

The LCD (Liquid Crystal Display) display the service code character(s) [A] to show the problem(s) which the DFI system, ignition system and immobilizer system has at the moment of diagnosis.




## Self-diagnosis Procedures

○When a problem occurs with the DFI system, ignition system and immobilizer system, the warning indications are as follows.

**DFI/Ignition System**

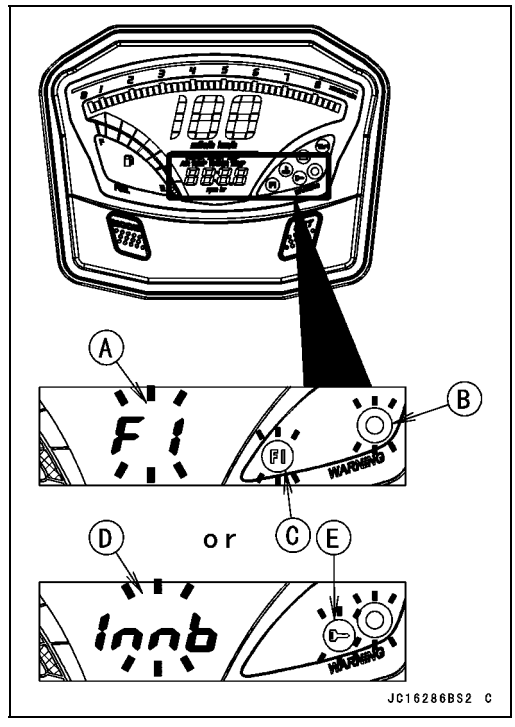
| "FI" Character [A]/Service Code Characters | Red Warning Indicator Light (LED) [B] | FI Warning Indicator [C] | Buzzer |
|---|---|---|---|
| Blinks | Goes on | Blinks | Sounds |

**Immobilizer System**

| Service Code Characters [D] | Red Warning Indicator Light (LED) | Immobilizer Warning Indicator [E] | Buzzer |
|---|---|---|---|
| Blinks | Blinks | Blinks | Sounds |

**NOTE**

○*Use a fully charged battery when conducting self-diagnosis. Otherwise, the character, indicator light and indicators do not go on or blink very slowly.*

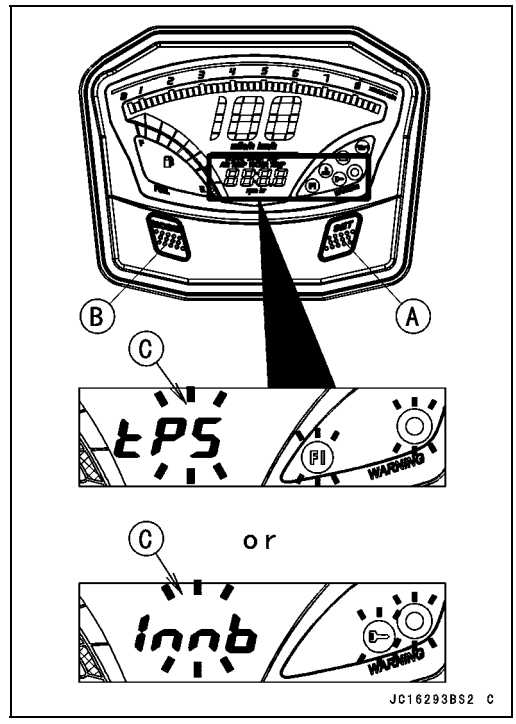


## Self-Diagnosis

- Insert the ignition key in the ignition switch to turn it on.

○If the immobilizer system has trouble, the service code character is displayed immediately on the LCD.

- Push the “SET” button [A] with “MODE” button [B] for more than three seconds.
- The service code character [C] is displayed on the LCD.



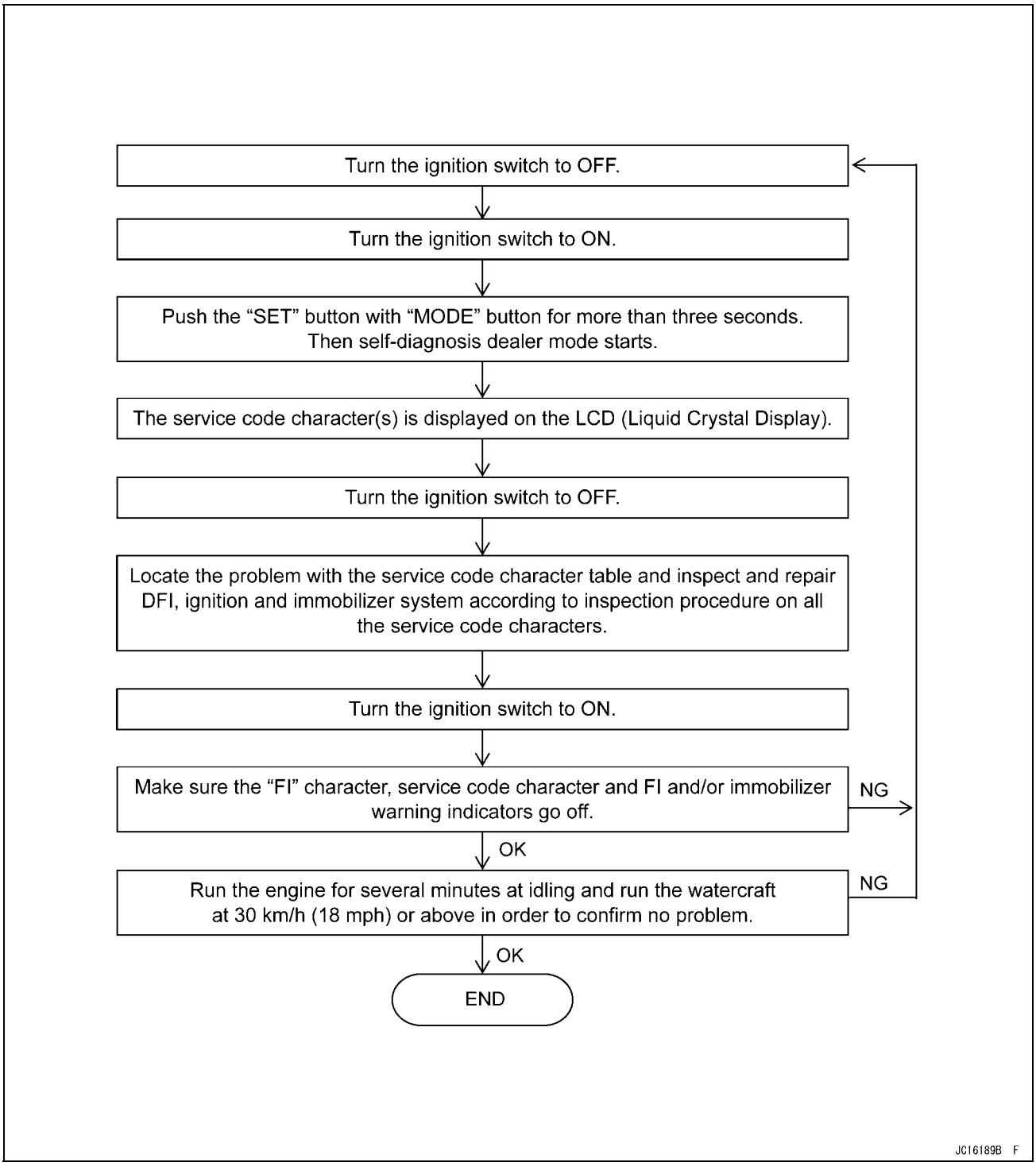

- Any of the following procedures ends self-diagnosis.

○When the service code character is displayed on the LCD, push either “SET” or “MODE” button for more than one second.

○When the ignition switch is turned OFF.

## Self-Diagnosis

### Self-Diagnosis Flow Chart


Turn the ignition switch to OFF.
Turn the ignition switch to ON.
Push the “SET” button with “MODE” button for more than three seconds.
Then self-diagnosis dealer mode starts.
The service code character(s) is displayed on the LCD (Liquid Crystal Display).
Turn the ignition switch to OFF.
Locate the problem with the service code character table and inspect and repair DFI, ignition and immobilizer system according to inspection procedure on all the service code characters.
Turn the ignition switch to ON.
Make sure the “FI” character, service code character and FI and/or immobilizer warning indicators go off.
NG
OK
Run the engine for several minutes at idling and run the watercraft at 30 km/h (18 mph) or above in order to confirm no problem.
NG
OK
END
JC16189B F

## Self-Diagnosis

### *Service Code Character Reading*

○The service code character(s) is displayed on the LCD.

○When there are a character of problems, all the service code characters can be stored and the display will begin starting from the lowest number service code character.

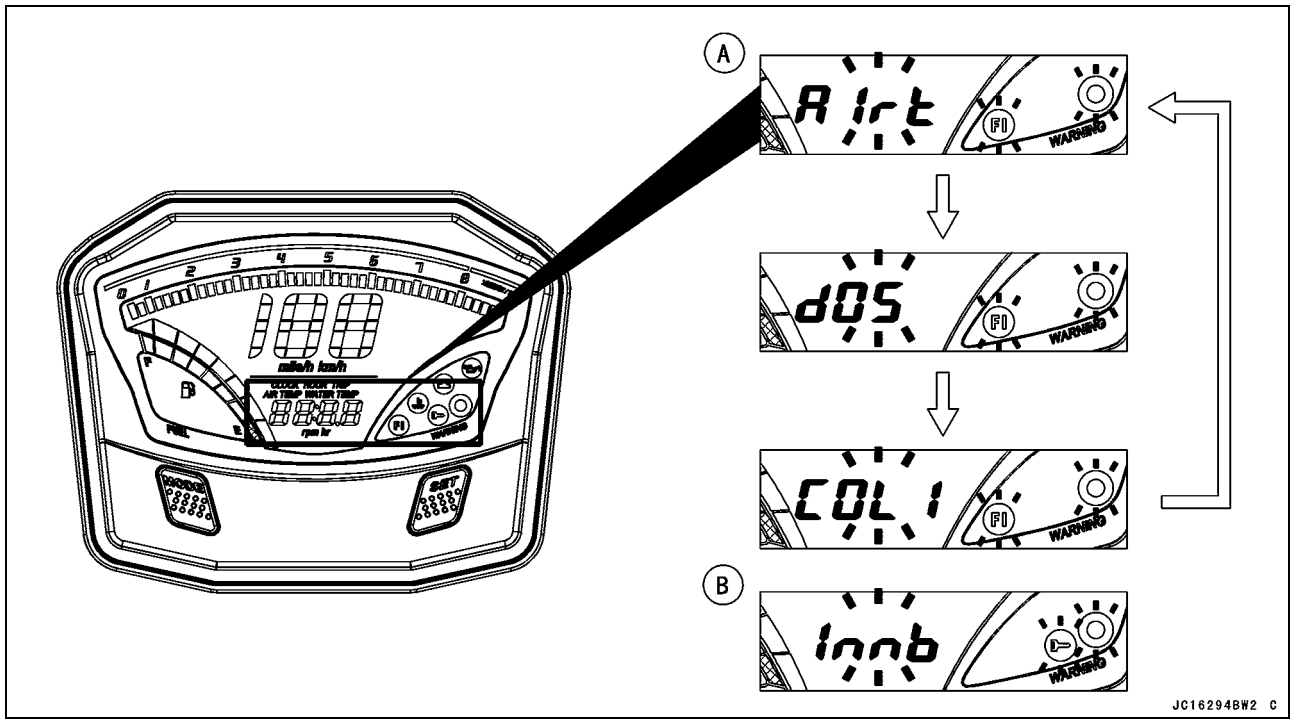
○Then after completing all codes, the display is repeated until the ignition switch is turned OFF or either “SET” or “MODE” button is pushed for more than one second.

○For example, if three problems occurred in the order of 51, 13, 31, the service code characters are displayed (each one second) from the lowest number service code character in the order listed as shown below.

13 (Alrt) → 31 (dOS) → 51 (COL1) → 13 (Alrt) → 31 (dOS) → 51 (COL1) →· · ·(repeated)

FI Trouble [A]

Immobilizer Trouble [B]




○If there is no problem or when the repair has been done, FI and/or immobilizer warning indicators go off and “FI” character and/or service code character is not displayed.

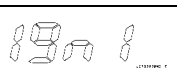
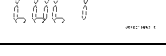
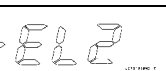
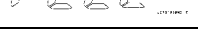
### *Service Code Erasing*

○When repair has been done, FI and/or immobilizer warning indicators go off and “FI” character and/or service code character is not displayed.

★But the service code characters stored in memory of the ECU are not erased to preserve the problem history. In this model, the problem history and the past service code characters can not be erased.

## Self-Diagnosis

### Service Code Character Table

| Service Code (used in ECU) | Service Code Character (displayed on Meter Unit) | Problems | Backups by ECU |
|---|---|---|---|
| 11 | | Throttle position sensor malfunction, wiring open or short. | The ECU locks ignition timing into the ignition timing at closed throttle position and sets the DFI in the D-J method (see Note 1). |
| 12 | | Intake air pressure sensor malfunction, wiring open or short. | The ECU sets the DFI in the α-N method (see Note 2). |
| 13 | | Intake air temperature sensor malfunction, wiring open or short. | The ECU sets the intake air temperature at 40°C. |
| 14 | | Water temperature sensor malfunction, wiring open or short. | The ECU sets the water temperature at 70°C. The ECU slows down the engine speed less than 3 000 r/min (rpm) by controlling the ignition. |
| 21 | | Crankshaft sensor malfunction, wiring open or short. | The engine stops by itself. |
| 23 | | Camshaft position sensor malfunction, wiring open or short. | The ECU continues to ignite cylinders in the same sequence following the last good signal. |
| 31 | | Vehicle-down sensor malfunction, wiring open or short. | The ECU slows down the engine speed less than 3 000 r/min (rpm) by controlling the ignition. |
| 35 | | Immobilizer amplifier malfunction. | – |
| 36 |  | Blank key detection. | – |
| 45 | | Fuel pump relay malfunction, wiring open. | – |
| 46 | | Fuel pump relay malfunction, relay is stuck. | – |
| 51 |  | Ignition coil #1, #4 malfunction, wiring open or short. | The ECU shuts off the injectors #1/#4 to stop fuel to the cylinders #1/#4. |
| 52 |  | Ignition coil #2, #3 malfunction, wiring open or short. | The ECU shuts off the injectors #2/#3 to stop fuel to the cylinders #2/#3. |
| 57 |  | System relay malfunction, relay is stuck. | – |
| 71 |  | Engine overheat | The ECU slows down the engine speed less than 3 000 r/min (rpm) by controlling the ignition. |
| 72 |  | Engine oil pressure too low | The ECU slows down the engine speed less than 3 000 r/min (rpm) by controlling the ignition. |
| 73 |  | Oil temperature sensor malfunction, wiring open or short. | The ECU sets the oil temperature at 60°C. The ECU slows down the engine speed less than 3 000 r/min (rpm) by controlling the ignition. |

## Self-Diagnosis

| Service Code (used in ECU) | Service Code Character (displayed on Meter Unit) | Problems | Backups by ECU |
|---|---|---|---|
| **75** | | ECU main relay malfunction, wiring is open or relay is stuck. | – |
| **76** | | Engine oil overheat | The ECU slows down the engine speed less than 3 000 r/min (rpm) by controlling the ignition. |

**Note:**

(1): D-J Method: When the engine load is light like at idling or low speed, the ECU determines the injection quantity by calculating from the throttle vacuum (intake air pressure sensor output voltage) and engine speed (crankshaft sensor output voltage). This method is called D-J method.

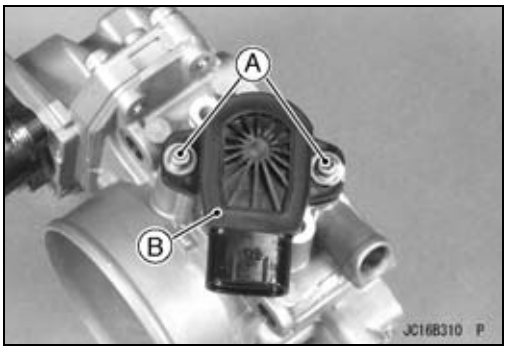
(2): α-N Method: As the engine speed increases, and the engine load turns middle to heavy, the ECU determines the injection quantity by calculating from the throttle opening (throttle position sensor output voltage) and the engine speed. This method is called α-N method.

## Throttle Position Sensor (Service Code/Character - 11/tPS)

### *Throttle Position Sensor Removal/Adjustment*

**NOTICE**

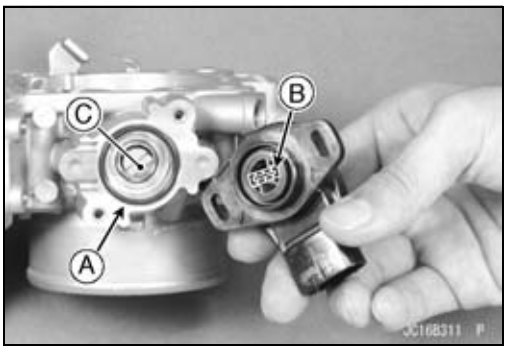
**A shock to the throttle position sensor can damage it. Do not drop the throttle position sensor.**



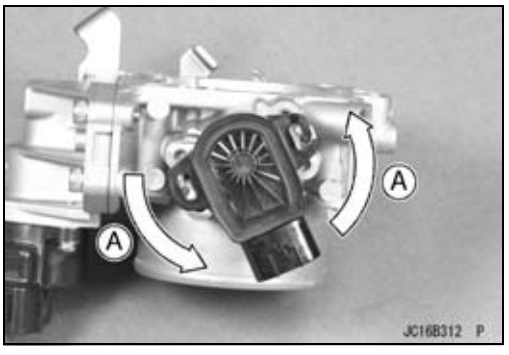

● Remove:
Throttle Body Assy (see Throttle Body Assy Removal)
Throttle Position Sensor Mounting Screws [A]
Throttle Position Sensor [B]

● When installing the throttle position sensor, note the following.

○Replace the O-ring [A] with a new one.
○Align the projections [B] on the throttle position sensor with the throttle shaft [C] as shown when putting the throttle position sensor to the throttle body assy.




○Turn the throttle position sensor counterclockwise [A] a little and temporarily tighten the throttle position sensor mounting screws.

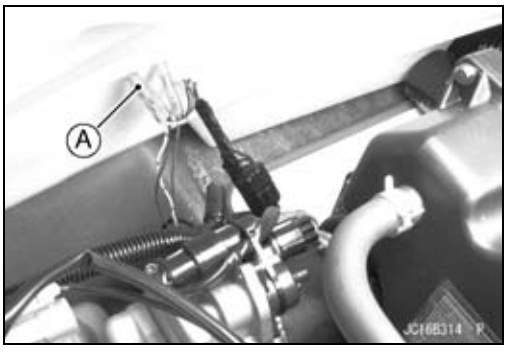



● Adjust the throttle position sensor positioning as follows.
○Install the throttle body assy and air box temporarily.
○After warming up the engine, check the idle speed.

**Idle Speed**
**Standard: 1 300 ±100 r/min (rpm)**

○Stop the engine and remove the ignition key.
○Disconnect the throttle position sensor connector and connect the throttle sensor setting adapter [A] between the harness connector and throttle position sensor connector.

**Special Tool - Throttle Sensor Setting Adapter: 57001 -1521**

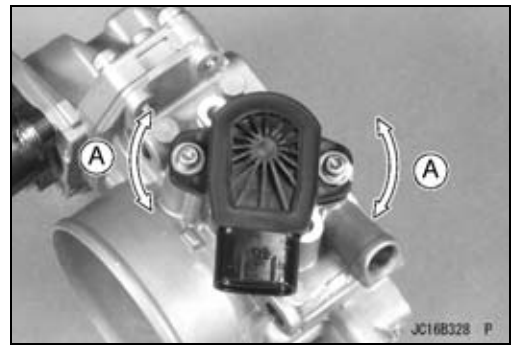



○Connect a digital meter to the throttle sensor setting adapter leads.

**Throttle Position Sensor Output Voltage**
**Connections to Adapter:**

**Digital Meter (+) → Y/W (sensor G/W) lead**
**Digital Meter (–) → BK/BL (sensor BK/W) lead**

## Throttle Position Sensor (Service Code/Character - 11/tPS)




○Start the engine with idle speed.
○Turn [A] the throttle position sensor and bring the sensor output voltage within the standard range.

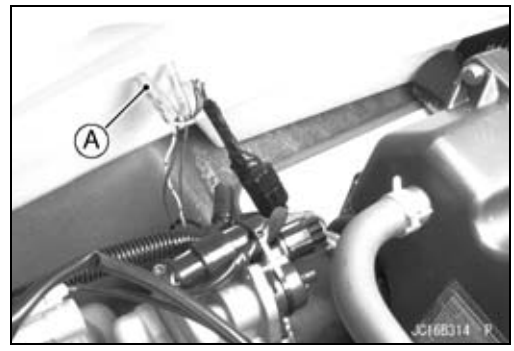
**Output Voltage**
**Standard: DC 1.08 ~ 1.18 V at idle throttle opening**

○Tighten the throttle position sensor mounting screws.

**Torque - Throttle Position Sensor Mounting Screws: 2.0 N·m (0.20 kgf·m, 18 in·lb)**

○Recheck the output voltage is within the standard range.
○Stop the engine and remove the ignition key.
○Remove the setting adapter and reconnect the throttle position sensor connector.

### *Throttle Position Sensor Input Voltage Inspection*




**NOTE**

○*Be sure the battery is fully charged.*

- Remove the ignition key.
- Remove the handrail plate (see Handrail Plate Removal in the Hull/Engine Hood chapter).
- Disconnect the throttle position sensor connector.
- Connect the setting adapter [A] between the main harness connector and throttle position sensor connector.

**Special Tool - Throttle Sensor Setting Adapter: 57001 -1521**

- Connect a digital meter to the setting adapter leads.

**Throttle Position Sensor Input Voltage**
**Connections to Adapter:**
**Digital Meter (+) → BL (sensor R) lead**
**Digital Meter (–) → BK/BL (sensor BK/W) lead**

- Measure the input voltage with the engine stopped and with the connector joined.
- Insert the ignition key in the ignition switch to turn it on.

**Input Voltage**
**Standard: DC 4.75 ~ 5.25 V**

- Remove the ignition key.

★If the reading is within the standard, check the output voltage (see Throttle Position Sensor Output Voltage Inspection).

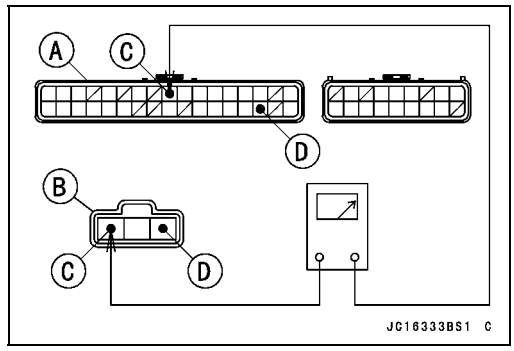
## Throttle Position Sensor (Service Code/Character - 11/tPS)

★If the reading is out of the standard, remove the ECU and check the wiring for continuity between main harness connectors.

**Special Tool - Hand Tester: 57001-1394**

○Disconnect the ECU and sensor connectors.

**Wiring Continuity Inspection**
**ECU Connector [A] ←→**
**Throttle Position Sensor Connector [B]**
**R lead (ECU terminal 9) [C]**
**BK/W lead (ECU terminal 32) [D]**



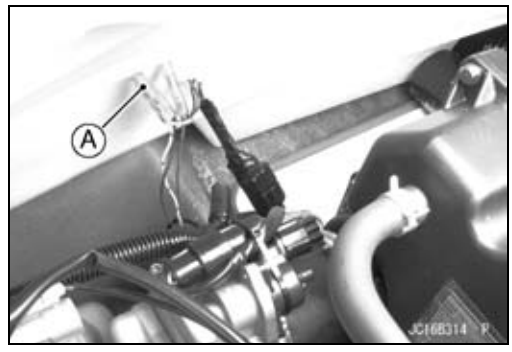

★If the wiring is good, check the ECU for its ground and power supply (see ECU Power Supply Inspection).
★If the ground and power supply are good, replace the ECU (see ECU Removal/Installation).

### *Throttle Position Sensor Output Voltage Inspection*

● Measure the output voltage at the throttle position sensor in the same way as input voltage inspection, note the following.

○Disconnect the throttle position sensor connector and connect the setting adapter [A] between these connectors.

**Special Tool - Throttle Sensor Setting Adapter: 57001 -1521**




**Throttle Position Sensor Output Voltage**
**Connections to Adapter:**
**Digital Meter (+) → Y/W (sensor G/W) lead**
**Digital Meter (–) → BK/BL (sensor BK/W) lead**

● Start the engine and warm it up thoroughly.
● Check idle speed to ensure the throttle opening is correct.

**Idle Speed**
**Standard: 1 300 ±100 r/min (rpm)**

## Throttle Position Sensor (Service Code/Character - 11/tPS)

- Remove the ignition key.
- Measure the output voltage with the engine stopped and with the connector joined.
- Insert the ignition key in the ignition switch to turn it on.

**Output Voltage**
**Standard: DC 1.08 ~ 1.18 V at idle throttle opening**
**DC 4.38 ~ 4.42 V at full throttle opening (for reference)**

**NOTE**

○*Open the throttle, confirm the output voltage will be raise.*
○*The standard voltage refers to the value when the voltage reading at the Input Voltage Inspection shows 5 V exactly.*
○*When the input voltage reading shows other than 5 V, derive a voltage range as follows.*
*Example:*
*In the case of a input voltage of 4.75 V.*
*1.08 × 4.75 ÷ 5.00 = 1.026 V*
*1.18 × 4.75 ÷ 5.00 = 1.121 V*
*Thus, the valid range is 1.026 ~ 1.121 V*

- Remove the ignition key.

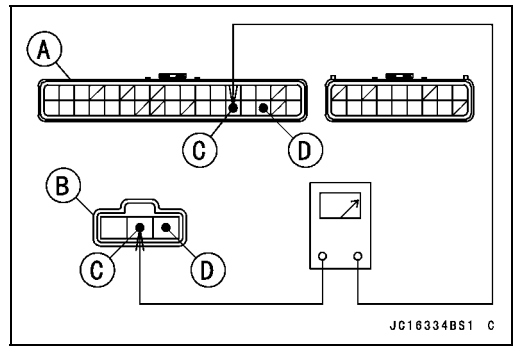
★If the reading is out of the standard, check the throttle position sensor resistance (see Throttle Position Sensor Resistance Inspection).

★If the reading is within the standard, remove the ECU and check the wiring for continuity between main harness connectors.

**Special Tool - Hand Tester: 57001-1394**

○Disconnect the ECU and sensor connectors.

**Wiring Continuity Inspection**
**ECU Connector [A] ←→**
**Throttle Position Sensor Connector [B]**
**G/W lead (ECU terminal 30) [C]**
**BK/W lead (ECU terminal 32) [D]**

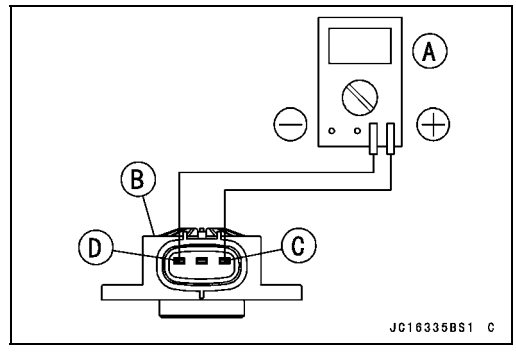



★If the wiring is good, check the ECU for its ground and power supply (see ECU Power Supply Inspection).
★If the ground and power supply are good, replace the ECU (see ECU Removal/Installation).

### *Throttle Position Sensor Resistance Inspection*

- Remove the ignition key.
- Remove the throttle body assy (see Throttle Body Assy Removal).
- Connect a digital meter [A] to the throttle position sensor connector [B].
- Measure the throttle position sensor resistance.

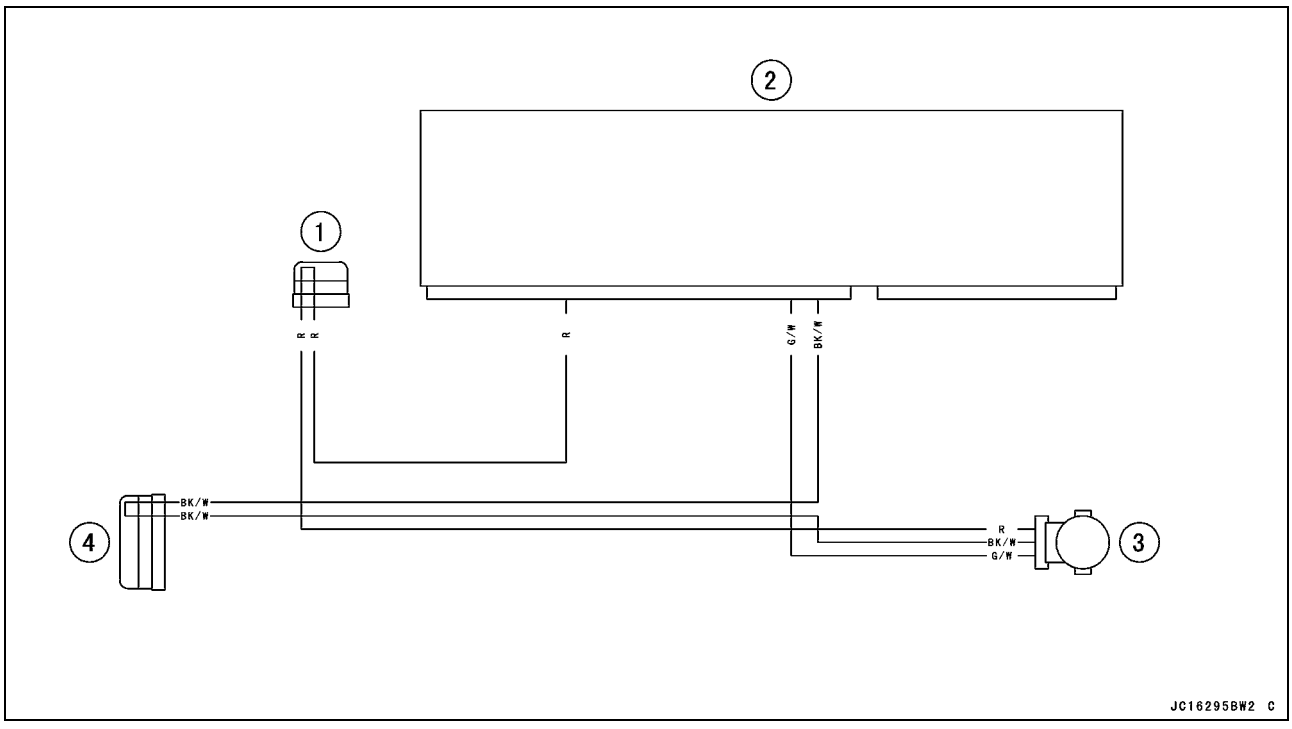
**Throttle Position Sensor Resistance**
**Connections: R lead [C] ←→ BK/W lead [D]**
**Standard: 4 ~ 6 kΩ**




★If the reading is out of the standard, replace the sensor.
★If the reading is within the standard, but the problem still exists, replace the ECU (see ECU Removal/Installation).

## Throttle Position Sensor (Service Code/Character - 11/tPS)

### Throttle Position Sensor Circuit



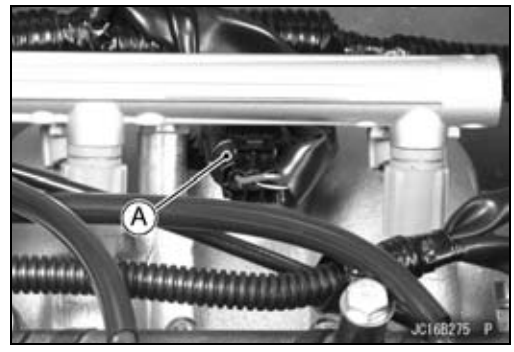

1. Joint Connector F (5 V)
2. ECU
3. Throttle Position Sensor
4. Joint Connector B (Ground)

## Intake Air Pressure Sensor (Service Code/Character - 12/bOSt)

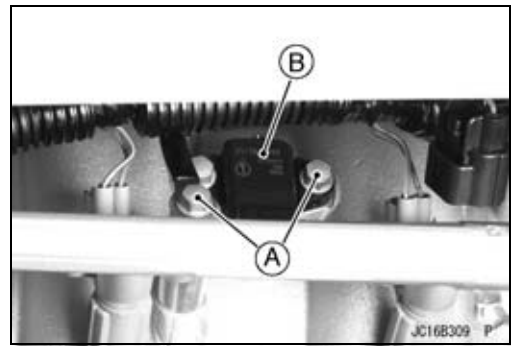
### *Intake Air Pressure Sensor Removal*

**NOTICE**

**A shock to the intake air pressure sensor can damage it. Do not drop the intake air pressure sensor.**




- Remove:
  Seats (see Seat Removal in the Hull/Engine Hood chapter)
  Intake Air Pressure Sensor Connector [A]



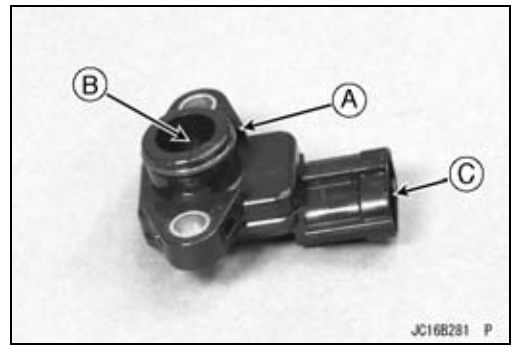

- Remove:
  Intake Air Pressure Sensor Bolts [A]
  Intake Air Pressure Sensor [B]

### *Intake Air Pressure Sensor Installation*

- Apply silicone oil to the O-ring [A].

**NOTICE**

**Do not apply silicone oil to the sensor end (sensing part) [B] and the inside [C] of the sensor connector.**

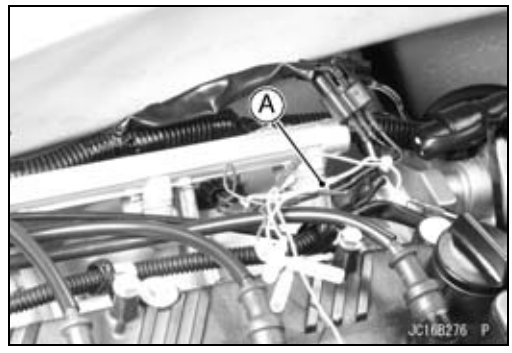



- Tighten:

**Torque - Intake Air Pressure Sensor Bolts: 7.8 N·m (0.80 kgf·m, 69 in·lb)**

## Intake Air Pressure Sensor (Service Code/Character - 12/bOSt)

### *Intake Air Pressure Sensor Input Voltage Inspection*




**NOTE**

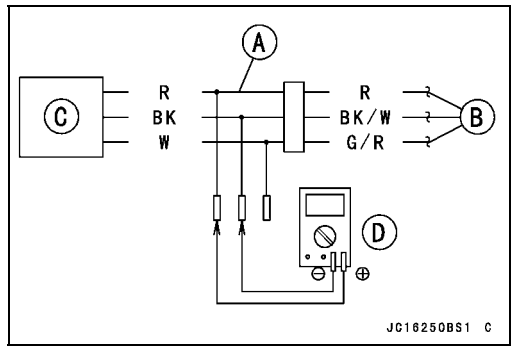
○*Be sure the battery is fully charged.*

- Remove the ignition key.
- Remove the seats (see Seat Removal in the Hull/Engine Hood chapter).
- Disconnect the intake air pressure sensor connector and connect the measuring adapter [A] between these connectors as shown in the figure.
  Main Harness [B]
  Intake Air Pressure Sensor [C]

**Special Tool - Measuring Adapter: 57001-1700**

- Connect a digital meter [D] to the measuring adapter leads.

**Intake Air Pressure Sensor Input Voltage**
**Connections to Adapter:**
**Digital Meter (+) → R (sensor R) lead**
**Digital Meter (–) → BK (sensor BK/W) lead**




- Measure the input voltage with the engine stopped and with the connector joined.
- Insert the ignition key in the ignition switch to turn it on.

**Input Voltage**
**Standard: DC 4.75 ~ 5.25 V**

- Remove the ignition key.

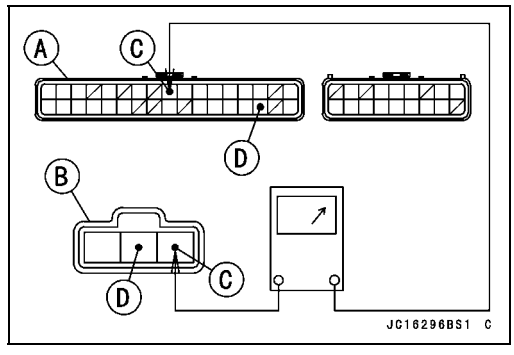
★If the reading is within the standard, check the output voltage (see Intake Air Pressure Sensor Output Voltage Inspection).

★If the reading is out of the standard, remove the ECU and check the wiring for continuity between main harness connectors.

**Special Tool - Hand Tester: 57001-1394**

○Disconnect the ECU and sensor connectors.

**Wiring Continuity Inspection**
**ECU Connector [A] ←→**
**Intake Air Pressure Sensor Connector [B]**
**R lead (ECU terminal 9) [C]**
**BK/W lead (ECU terminal 32) [D]**

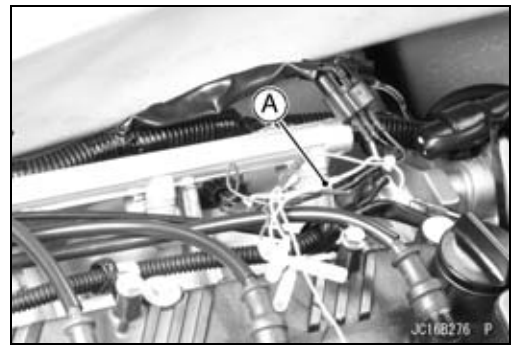



★If the wiring is good, check the ECU for its ground and power supply (see ECU Power Supply Inspection).

★If the ground and power supply are good, replace the ECU (see ECU Removal/Installation).

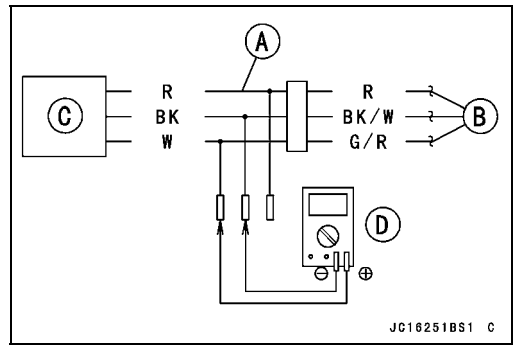
## Intake Air Pressure Sensor (Service Code/Character - 12/bOSt)

### *Intake Air Pressure Sensor Output Voltage Inspection*




- Measure the output voltage at the intake air pressure sensor in the same way as input voltage inspection, note the following.

○Disconnect the intake air pressure sensor connector and connect the measuring adapter [A] between these connectors as shown in the figure.
Main Harness [B]
Intake Air Pressure Sensor [C]
Digital Meter [D]




**Special Tool - Measuring Adapter: 57001-1700**

**Intake Air Pressure Sensor Output Voltage**
**Connections to Adapter:**
**Digital Meter (+) → W (sensor G/R) lead**
**Digital Meter (–) → BK (sensor BK/W) lead**

- Measure the output voltage with the engine stopped and with the connector joined.
- Insert the ignition key in the ignition switch to turn it on.

**Output Voltage**
**Usable Range: DC 3.75 ~ 4.25 V at standard atmospheric pressure (101.32 kPa, 76 cmHg)**

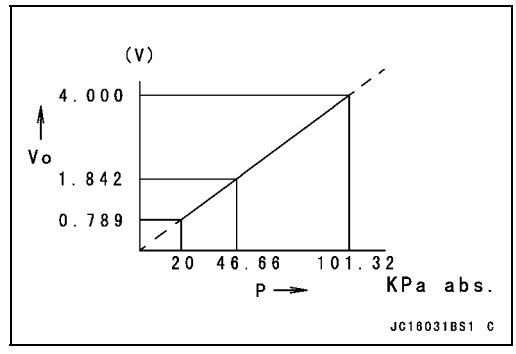
**NOTE**

○*The output voltage changes according to local atmospheric pressure.*

- Remove the ignition key.

★If the reading is out of the usable range, replace the sensor.

**Output Voltage Performance**
**(at Input Voltage: 4.75 ~ 5.25 V)**
P: Vacuum Pressure
Vo: Output Voltage



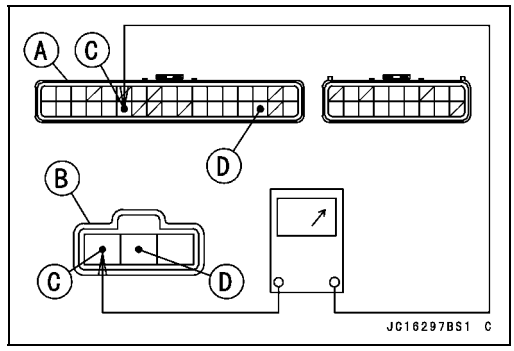
## Intake Air Pressure Sensor (Service Code/Character - 12/bOSt)

★If the reading is within the usable range, remove the ECU and check the wiring for continuity between main harness connector.

**Special Tool - Hand Tester: 57001-1394**

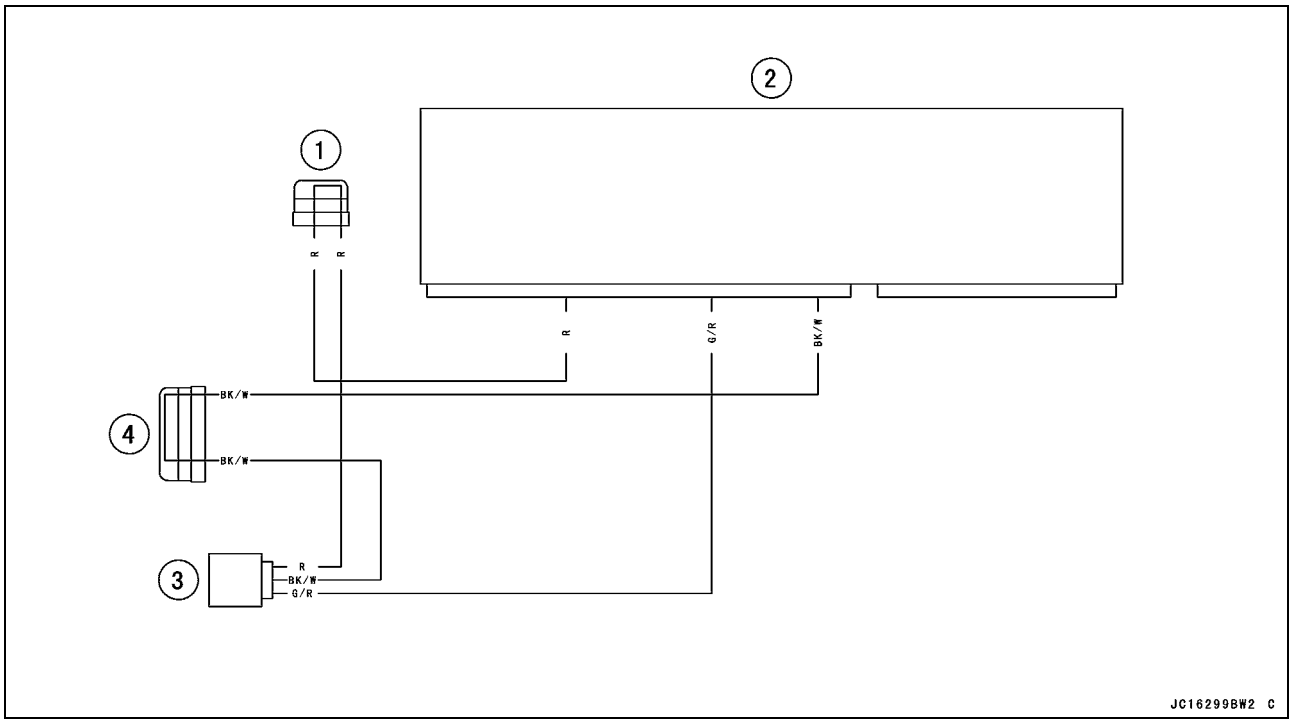
○Disconnect the ECU and sensor connectors.

**Wiring Continuity Inspection**
**ECU Connector [A] ←→**
**Intake Air Pressure Sensor Connector [B]**
**G/R lead (ECU terminal 23) [C]**
**BK/W lead (ECU terminal 32) [D]**




★If the wiring is good, check the ECU for its ground and power supply (see ECU Power Supply Inspection).
● If the ground and power supply are good, replace the ECU (see ECU Removal/Installation).

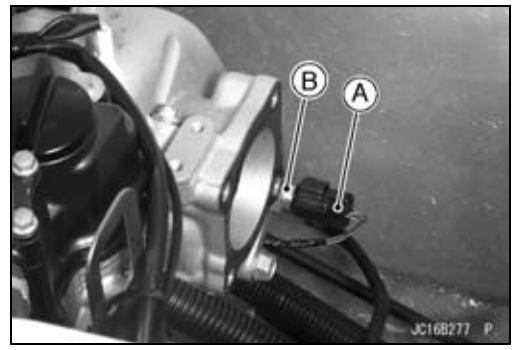
### Intake Air Pressure Sensor Circuit




1. Joint Connector F (5 V)
2. ECU
3. Intake Air Pressure Sensor
4. Joint Connector B (Ground)

## Intake Air Temperature Sensor (Service Code/Character - 13/AIrt)

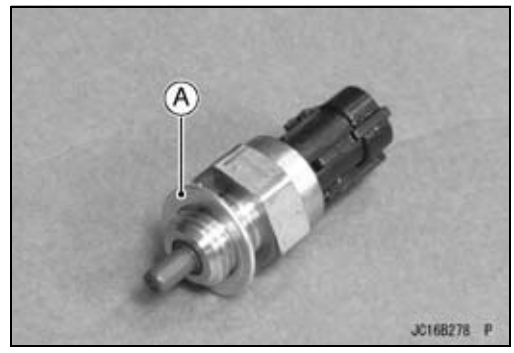
### *Intake Air Temperature Sensor Removal/Installation*




**NOTICE**

**A shock to the intake air temperature sensor can damage it. Do not drop the intake air temperature sensor.**

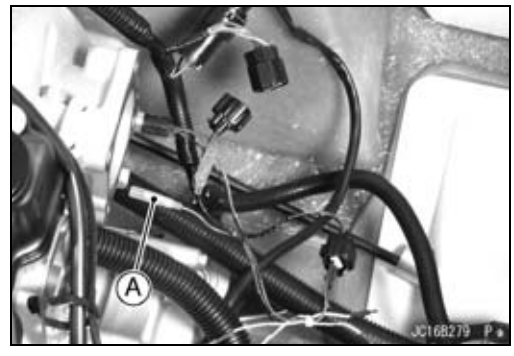
- Remove the throttle body assy (see Throttle Body Assy Removal).
- Disconnect the connector [A].
- Remove the intake air temperature sensor [B] and washer.




- Install the intake air temperature sensor and washer [A].
- Tighten:

**Torque - Intake Air Temperature Sensor: 20 N·m (2.0 kgf·m, 15 ft·lb)**

### *Intake Air Temperature Sensor Output Voltage Inspection*

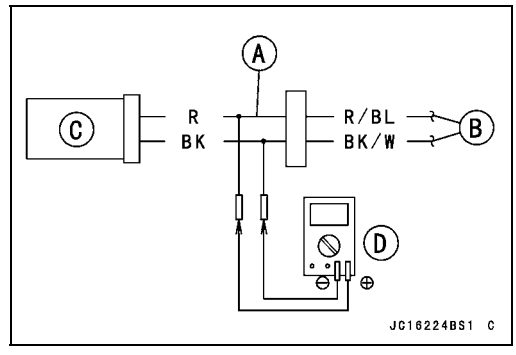



**NOTE**

○*Be sure the battery is fully charged.*

- Remove the ignition key.
- Remove the throttle body assy (see Throttle Body Assy Removal).
- Disconnect the intake air temperature sensor connector and connect the measuring adapter [A] between these connectors as shown in the figure.
  Main Harness [B]
  Intake Air Temperature Sensor [C]

**Special Tool - Measuring Adapter: 57001-1700**




- Connect a digital meter [D] to the measuring adapter leads.

**Intake Air Temperature Sensor Output Voltage**
**Connections to Adapter:**
**Digital Meter (+) → R (sensor R/BL) lead**
**Digital Meter (–) → BK (sensor BK/W) lead**

- Measure the output voltage with the engine stopped and with the connector joined.
- Insert the ignition key in the ignition switch to turn it on.

**Output Voltage**
**Standard: About DC 2.25 ~ 2.50 V at intake air temperature 20°C (68°F)**

**NOTE**

○*The output voltage changes according to the intake air temperature.*

## Intake Air Temperature Sensor (Service Code/Character - 13/AIrt)

- Remove the ignition key.

★If the reading is within the standard, check the ECU for its ground and power supply (see ECU Power Supply Inspection).

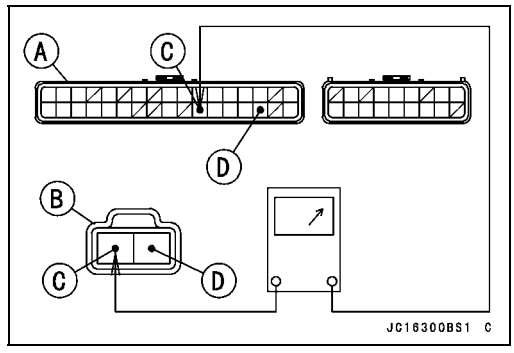
★If the ground and power supply are good, replace the ECU (see ECU Removal/Installation).

★If the reading is out of the standard, remove the ECU and check the wiring for continuity between main harness connectors.

**Special Tool - Hand Tester: 57001-1394**

○Disconnect the ECU and sensor connectors.

**Wiring Continuity Inspection**
**ECU Connector [A] ←→**
**Intake Air Temperature Sensor Connector [B]**
**R/BL lead (ECU terminal 28) [C]**
**BK/W lead (ECU terminal 32) [D]**




★If the wiring is good, check the intake air temperature sensor resistance (see Intake Air Temperature Sensor Resistance Inspection).

### *Intake Air Temperature Sensor Resistance Inspection*

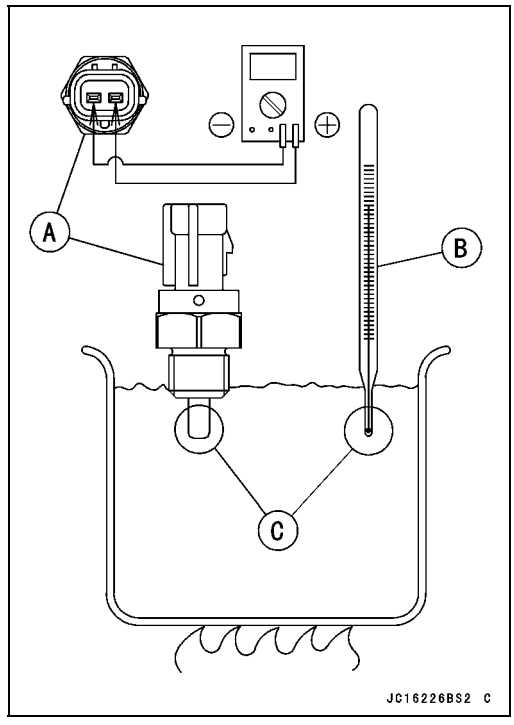
- Remove the intake air temperature sensor (see Intake Air Temperature Sensor Removal/Installation).
- Suspend the sensor [A] in a container of machine oil so that the heat-sensitive portion and threaded portion are submerged.
- Suspend a thermometer [B] with the heat-sensitive portion [C] located in almost the same depth with the sensor.

**NOTE**

○*The sensor and thermometer must not touch the container side or bottom.*

- Place the container over a source of heat and gradually raise the temperature of the oil while stirring the oil gently for even temperature.
- Using a digital meter, measure the internal resistance of the sensor across the terminals at the temperatures shown in the following.

**Intake Air Temperature Sensor Resistance**
**Standard: 5.4 ~ 6.6 kΩ at 0°C (32°F)**
**0.29 ~ 0.39 kΩ at 80°C (176°F)**

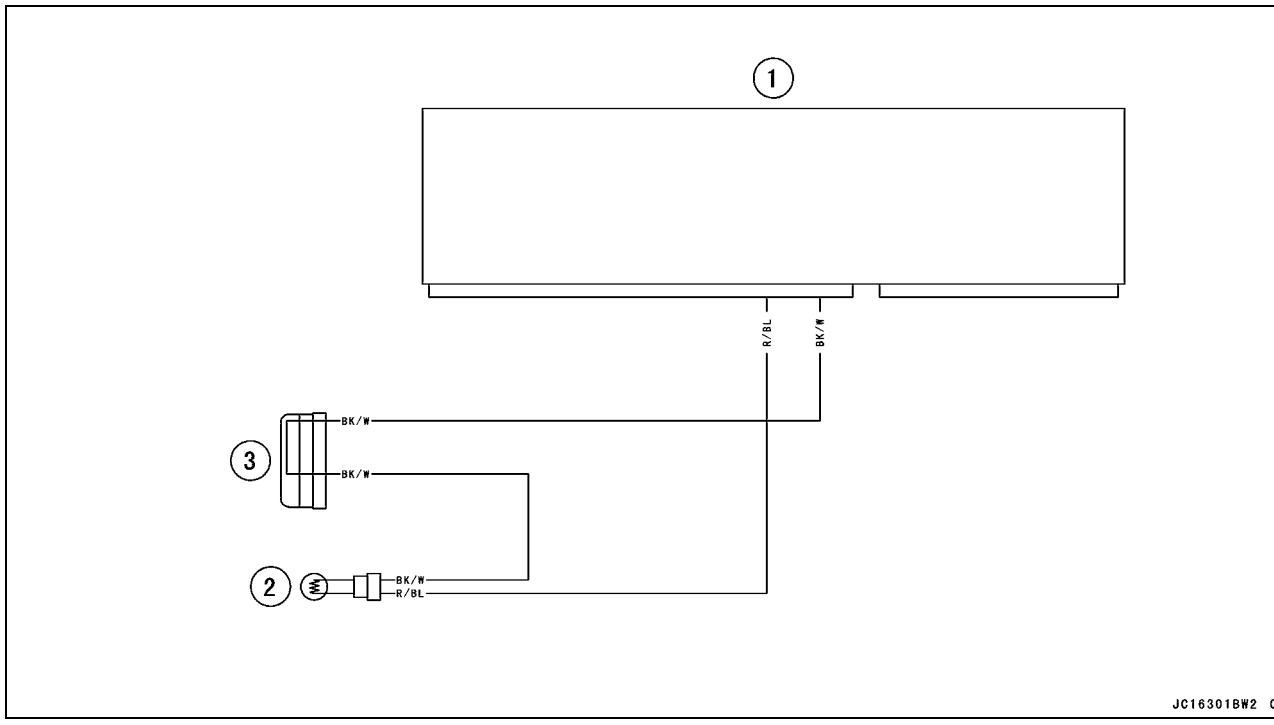



★If the reading is out of the standard, replace the sensor.

★If the reading is within the standard, but the problem still exists, replace the ECU (see ECU Removal/Installation).

## Intake Air Temperature Sensor (Service Code/Character - 13/AIrt)

### Intake Air Temperature Sensor Circuit



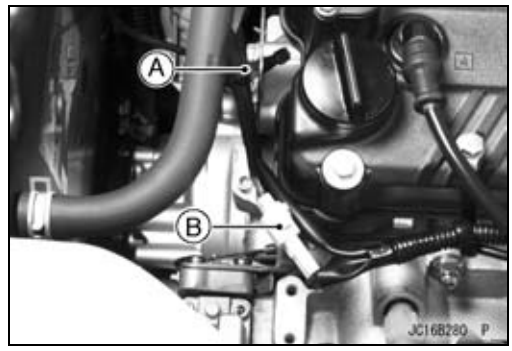

1. ECU
2. Intake Air Temperature Sensor
3. Joint Connector B (Ground)

## Water Temperature Sensor (Service Code/Character - 14/AqUt)

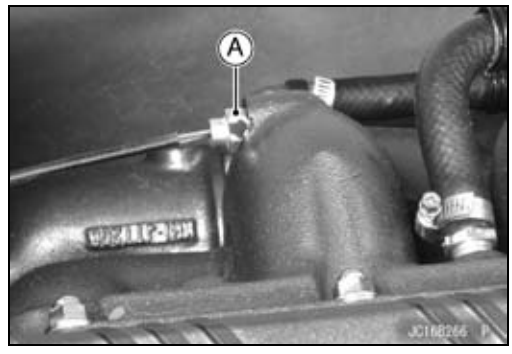
### *Water Temperature Sensor Removal/Installation*

**NOTICE**

**A shock to the water temperature sensor can damage it. Do not drop the water temperature sensor.**

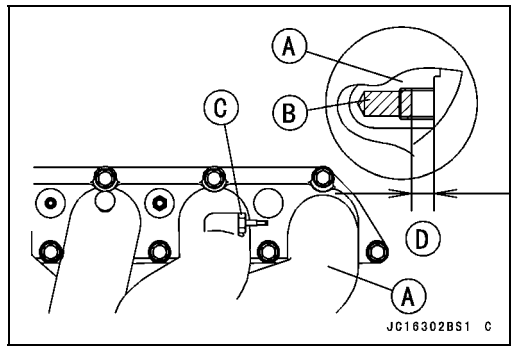



- Remove the seats (see Seat Removal in the Hull/Engine Hood chapter).
- Cut the band [A].
- Disconnect the connector [B].




- Unscrew the water temperature sensor [A].

- Fill the hollow of the exhaust manifold [A] with the engine oil (10W-30) [B] as shown in the figure, before installing the water temperature sensor [C].
  5 ~ 10 mm (0.2 ~ 0.4 in.) [D]




**NOTE**

○*When filling the engine oil in the hollow of the exhaust manifold, remove the exhaust manifold. Fill the engine oil and install the water temperature sensor.*

**NOTICE**

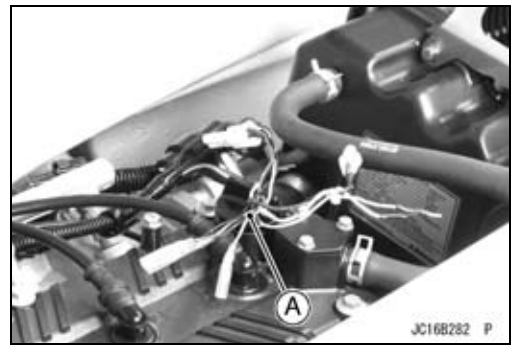
**Overfilling the engine with oil may damage the fitting boss. Do not overfill the engine oil.**

- Tighten:

**Torque - Water Temperature Sensor: 14.7 N·m (1.5 kgf·m, 11 ft·lb)**

## Water Temperature Sensor (Service Code/Character - 14/AqUt)

### *Water Temperature Sensor Output Voltage Inspection*




**NOTE**

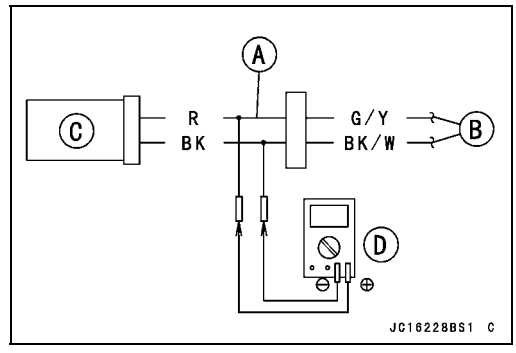
○*Be sure the battery is fully charged.*

- Remove the ignition key.
- Remove the seats (see Seat Removal in the Hull/Engine Hood chapter).
- Disconnect the water temperature sensor connector and connect the measuring adapter [A] between these connectors as shown in the figure.
  Main Harness [B]
  Water Temperature Sensor [C]

**Special Tool - Measuring Adapter: 57001-1700**

- Connect a digital meter [D] to the measuring adapter leads.

**Water Temperature Sensor Output Voltage**
**Connections to Adapter:**
**Digital Meter (+) → R (sensor G/Y) lead**
**Digital Meter (–) → BK (sensor BK/W) lead**




- Measure the output voltage with the engine stopped and with the connector joined.
- Insert the ignition key in the ignition switch to turn it on.

**Output Voltage**
**Standard: About DC 3.5 ~ 4.0 V at 20°C (68°F)**

**NOTE**

○*The output voltage changes according to the water temperature in the engine.*

- Remove the ignition key.

★If the reading is within the standard, check the ECU for its ground and power supply (see ECU Power Supply Inspection).

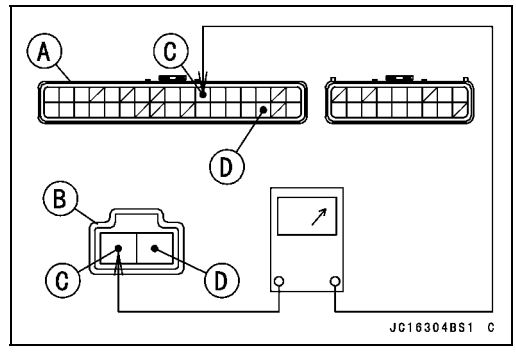
★If the ground and power supply are good, replace the ECU (see ECU Removal/Installation).

★If the reading is out of the standard, remove the ECU and check the wiring for continuity between main harness connectors.

**Special Tool - Hand Tester: 57001-1394**

○Disconnect the ECU and sensor connectors.

**Wiring Continuity Inspection**
**ECU Connector [A] ←→**
**Water Temperature Sensor Connector [B]**
**G/Y lead (ECU terminal 11) [C]**
**BK/W lead (ECU terminal 32) [D]**




★If the wiring is good, check the water temperature sensor resistance (see Water Temperature Sensor Resistance Inspection).

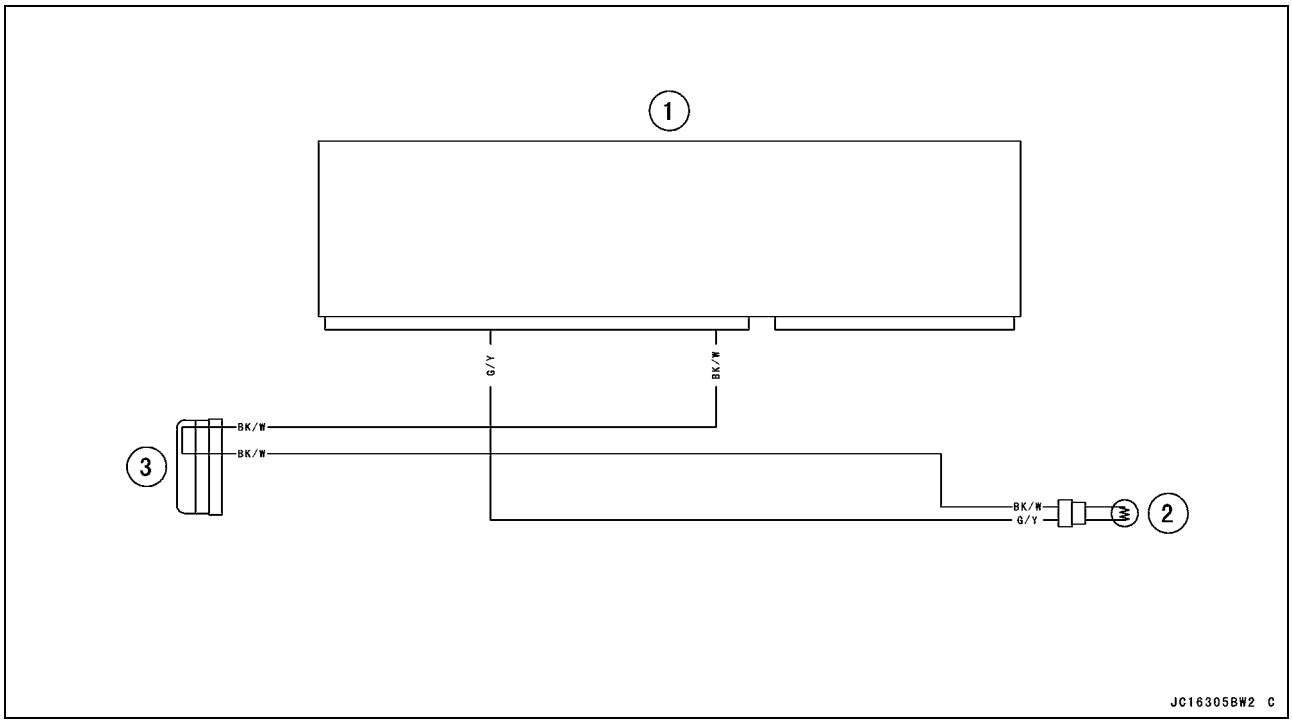
## Water Temperature Sensor (Service Code/Character - 14/AqUt)

### *Water Temperature Sensor Resistance Inspection*

- Refer to the Water Temperature Sensor Inspection in the Electrical System chapter.

★If the reading is within the standard, but the problem still exists, replace the ECU (see ECU Removal/Installation).

### Water Temperature Sensor Circuit




1. ECU
2. Water Temperature Sensor
3. Joint Connector B (Ground)

## Crankshaft Sensor (Service Code/Character - 21/CrAg)

The crankshaft sensor has no power source, and when the engine stops, the crankshaft sensor generates no signals.

### *Crankshaft Sensor Removal/Installation*

- Refer to the Crankshaft Sensor Removal/Installation in the Electrical System chapter.

### *Crankshaft Sensor Resistance Inspection*

- Refer to the Crankshaft Sensor Inspection in the Electrical System chapter.

★If the reading is within the standard, check the peak voltage (see Crankshaft Sensor Peak Voltage Inspection).

### *Crankshaft Sensor Peak Voltage Inspection*

- Refer to the Crankshaft Sensor Peak Voltage Inspection in the Electrical System chapter.

★If the reading is within the standard, remove the ECU and check the wiring for continuity between main harness connectors.

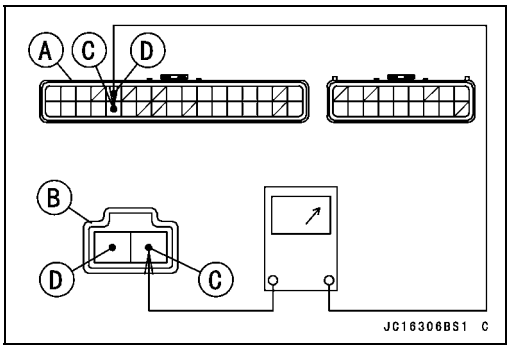
**Special Tool - Hand Tester: 57001-1394**

○Disconnect the ECU and sensor connectors.

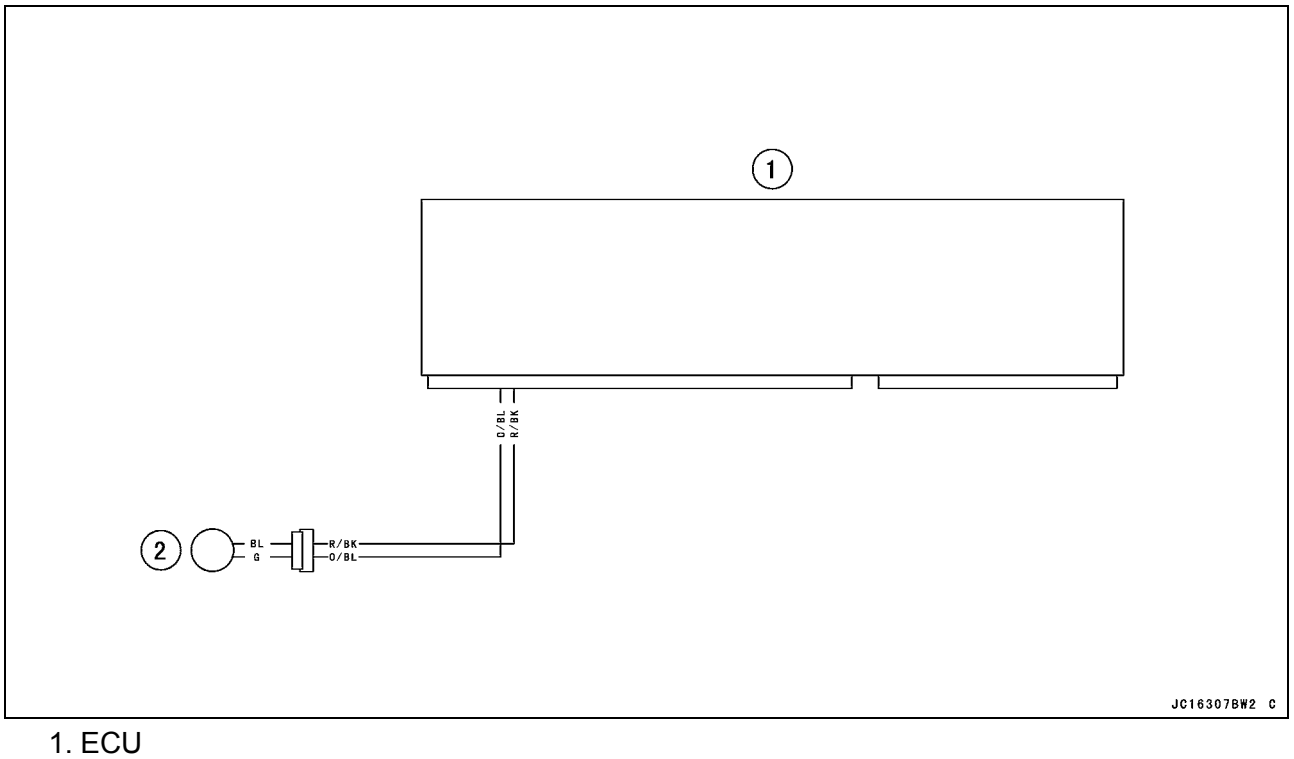
**Wiring Continuity Inspection**
**ECU Connector [A] ←→**
**Crankshaft Sensor Connector [B]**
**R/BK lead (ECU terminal 22) [C]**
**O/BL lead (ECU terminal 5) [D]**

★If the wiring is good, check the ECU for its ground and power supply (see ECU Power Supply Inspection).

★If the ground and power supply are good, replace the ECU (see ECU Removal/Installation).




### Crankshaft Sensor Circuit




1. ECU
2. Crankshaft Sensor

## Camshaft Position Sensor (Service Code/Character - 23/CAA1)

The camshaft position sensor detects the position of the camshaft, and distinguishes the cylinder.

### *Camshaft Position Sensor Removal/Installation*

- Refer to the Camshaft Position Sensor Removal/Installation in the Electrical System chapter.

### *Camshaft Position Sensor Resistance Inspection*

- Refer to the Camshaft Position Sensor Inspection in the Electrical System chapter.

★If the reading is within the standard, check the peak voltage (see Camshaft Position Sensor Peak Voltage Inspection).

### *Camshaft Position Sensor Peak Voltage Inspection*

- Refer to the Camshaft Position Sensor Peak Voltage Inspection in the Electrical System chapter.

★If the reading is within the standard, remove the ECU and check the wiring for continuity between main harness connectors.

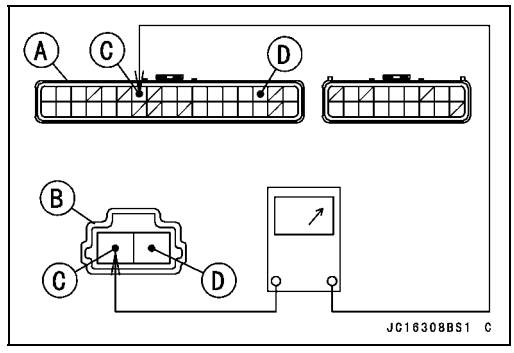
**Special Tool - Hand Tester: 57001-1394**

○Disconnect the ECU and sensor connectors.

**Wiring Continuity Inspection**
**ECU Connector [A] ←→**
**Camshaft Position Sensor Connector [B]**
**W/BL lead (ECU terminal 7) [C]**
**BK/W lead (ECU terminal 15, BK/R lead) [D]**

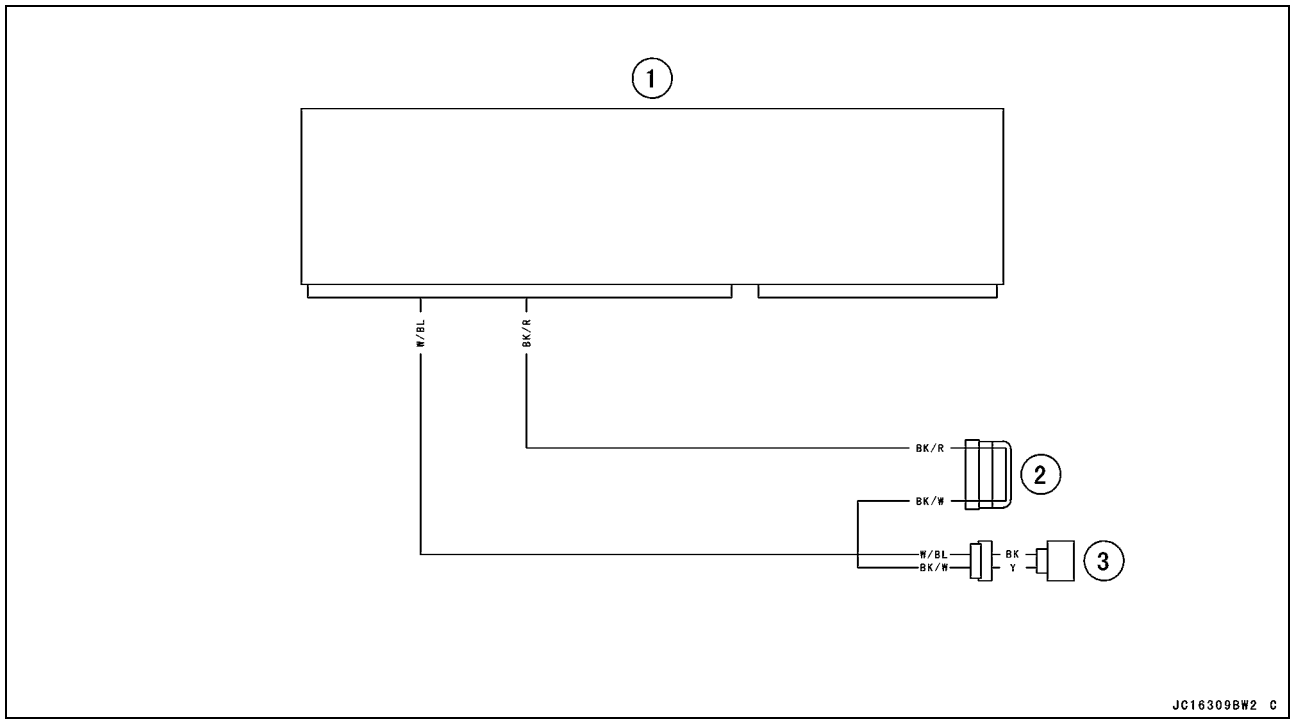
★If the wiring is good, check the ECU for its ground and power supply (see ECU Power Supply Inspection).

★If the ground and power supply are good, replace the ECU (see ECU Removal/Installation).



## Camshaft Position Sensor (Service Code/Character - 23/CAA1)

### Camshaft Position Sensor Circuit

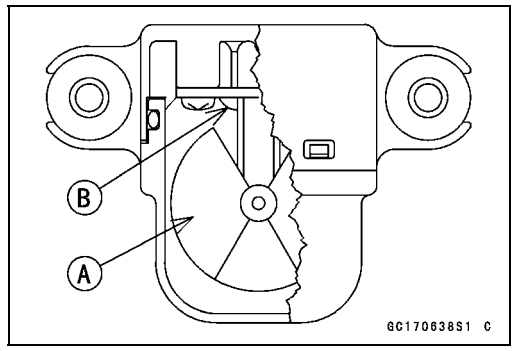



1. ECU
2. Joint Connector E (Ground)
3. Camshaft Position Sensor

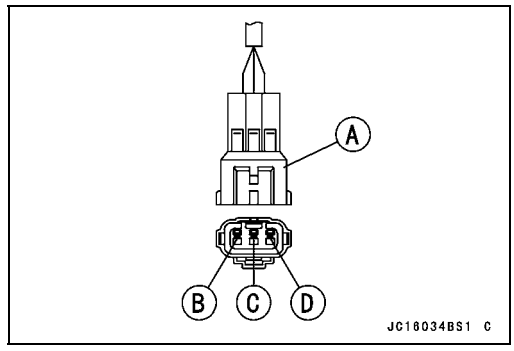
## Vehicle-down Sensor (Service Code/Character - 31/dOS)

This sensor has a weight [A] with two magnets inside, and sends a signal to the ECU. But when the watercraft banks 110 ~ 130° or more to either side (in fact falls down), the weight turns and shuts off the signal. The ECU senses this change, and stops the fuel pump, the fuel injectors, and the ignition system.

Hall IC [B]




Vehicle-down Sensor Connector [A]
Ground Terminal BK/W [B]
Output Terminal BL/W [C]
Power Source Terminal R/G [D]

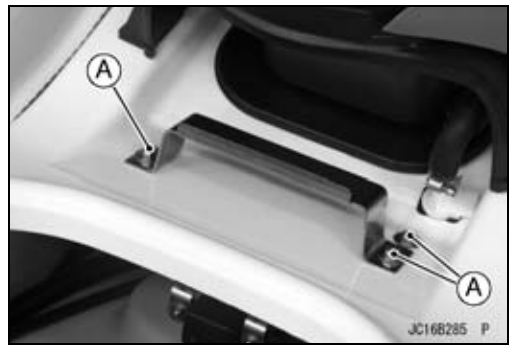



### *Vehicle-down Sensor Removal*

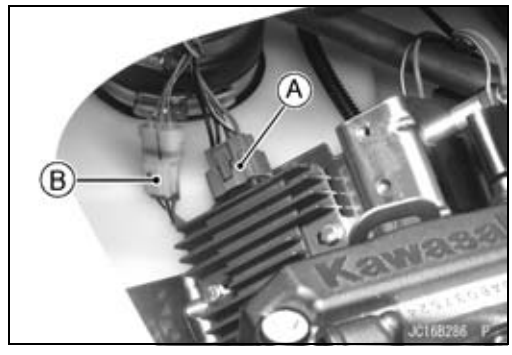
***NOTICE***

**A shock to the vehicle-down sensor can damage it. Do not drop the vehicle down sensor.**

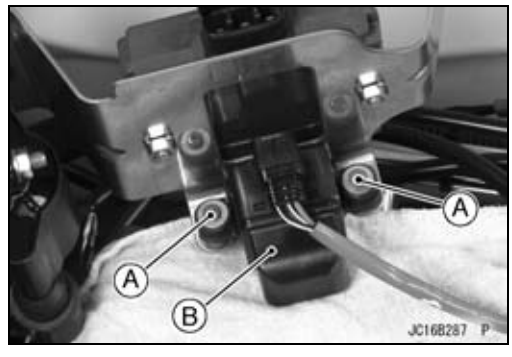
● Remove:
Seats (see Seat Removal in the Hull/Engine Hood chapter)
Bracket Bolts [A] and Washers




● Remove:
Regulator/Rectifier Lead Connector [A]
Vehicle-down Sensor Lead Connector [B]

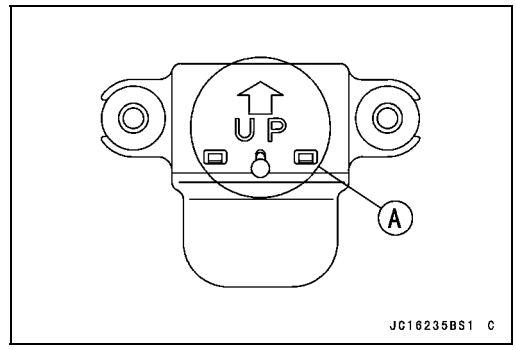



● Remove:
Screws [A]
Vehicle-down Sensor [B]



## Vehicle-down Sensor (Service Code/Character - 31/dOS)

### *Vehicle-down Sensor Installation*




● The UP mark [A] of the sensor should face upward.

**⚠ WARNING**

**Incorrect installation of the vehicle-down sensor could cause sudden loss of engine power. The rider could lose balance during certain riding situations for an accident resulting in injury or death. Ensure that the vehicle-down sensor is held in place by the sensor bracket.**

● Tighten:

**Torque - Vehicle-down Sensor Mounting Screws: 1.5 N·m (0.15 kgf·m, 13 in·lb)**

● Connect the connectors.

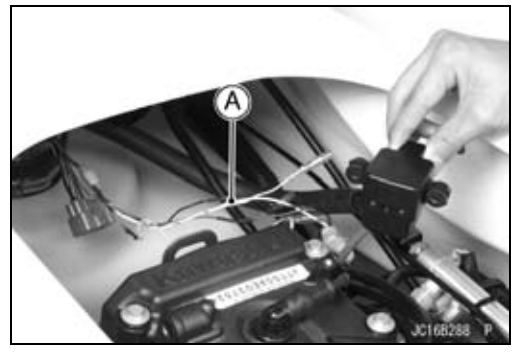
● Apply a non-permanent locking agent to the threads of the bracket bolts, and tighten them.

**Torque - Bracket Bolts: 8.8 N·m (0.90 kgf·m, 78 in·lb)**

### *Vehicle-down Sensor Input Voltage Inspection*

**NOTE**

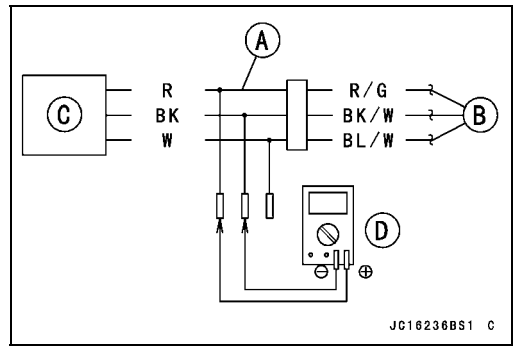
○*Be sure the battery is fully charged.*




● Remove the ignition key.

● Remove the seats (see Seat Removal in the Hull/Engine Hood chapter).

● Disconnect the vehicle-down sensor connector and connect the measuring adapter [A] between these connectors as shown in the figure.
Main Harness [B]
Vehicle-down Sensor [C]




**Special Tool - Measuring Adapter: 57001-1700**

● Connect a digital meter [D] to the measuring adapter leads.

**Vehicle-down Sensor Input Voltage**
**Connections to Adapter:**
**Digital Meter (+) → R (sensor R/G) lead**
**Digital Meter (–) → BK (sensor BK/W) lead**

● Measure the input voltage with the engine stopped and with the connector joined.

● Insert the ignition key in the ignition switch to turn it on.

**Input Voltage**
**Standard: DC 4.75 ~ 5.25 V**

● Remove the ignition key.

★If the reading is within the standard, check the output voltage (see Vehicle-down Sensor Output Voltage Inspection).

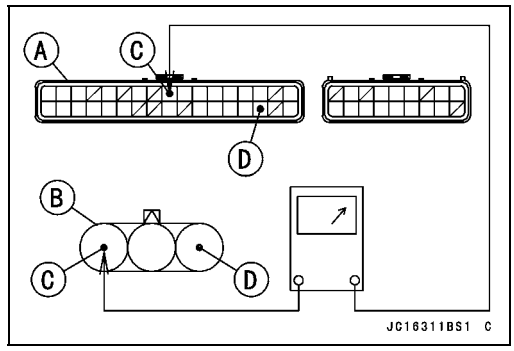
## Vehicle-down Sensor (Service Code/Character - 31/dOS)

★If the reading is out of the standard, remove the ECU and check the wiring for continuity between main harness connectors.

**Special Tool - Hand Tester: 57001-1394**

○Disconnect the ECU and sensor connectors.

**Wiring Continuity Inspection**
**ECU Connector [A] ←→**
**Vehicle-down Sensor Connector [B]**
**R/G lead (ECU terminal 9, R lead) [C]**
**BK/W lead (ECU terminal 32) [D]**




★If the wiring is good, check the ECU for its ground and power supply (see ECU Power Supply Inspection).
★If the ground and power supply are good, replace the ECU (see ECU Removal/Installation).

### *Vehicle-down Sensor Output Voltage Inspection*

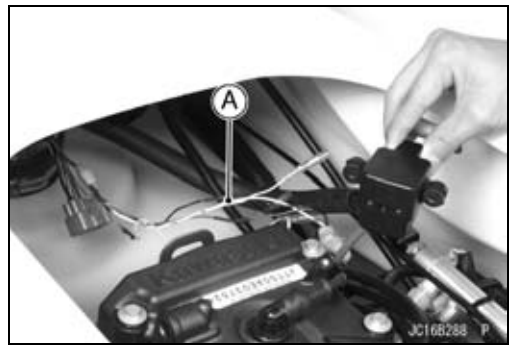
- Remove the vehicle-down sensor (see Vehicle-down Sensor Removal).
- Connect the measuring adapter [A] to the vehicle-down sensor connectors as shown in the figure.

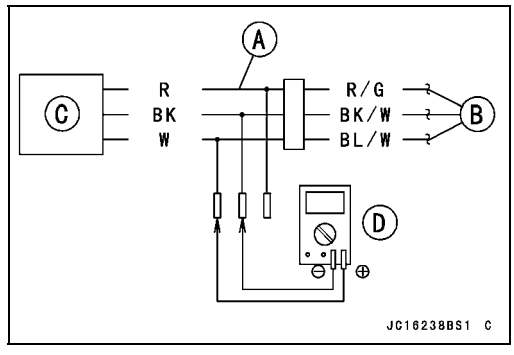
**Special Tool - Measuring Adapter: 57001-1700**

Main Harness [B]
Vehicle-down Sensor [C]

- Connect a digital meter [D] to the measuring adapter leads.

**Vehicle-down Sensor Output Voltage**
**Connections to Adapter:**
**Digital Meter (+) → W (sensor BL/W) lead**
**Digital Meter (–) → BK (sensor BK/W) lead**



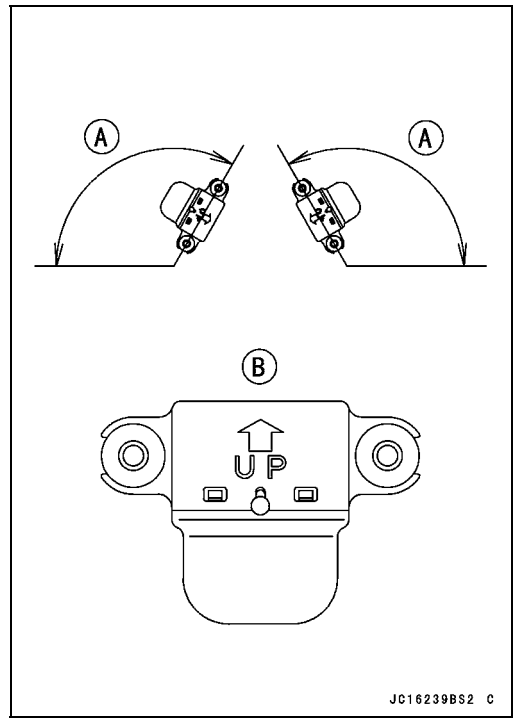
## Vehicle-down Sensor (Service Code/Character - 31/dOS)

- Hold the sensor vertically.
- Measure the output voltage with the engine stopped and with the connector joined.
- Insert the ignition key in the ignition switch to turn it on.
- Tilt the sensor 110 ~ 130° or more [A] right or left, then hold the sensor almost vertical with the arrow mark pointed up [B], and measure the output voltage.

**Output Voltage**

**Standard: With sensor tilted 110 ~ 130° or more right or left: DC 0.65 ~ 1.35 V**

**With sensor arrow mark pointed up: DC 3.55 ~ 4.45 V**




### NOTE

○*If you need to test again, remove the ignition key, and then insert the ignition key in the ignition switch to turn it on.*

- Remove the ignition key.

★If the reading is out of the standard, replace the sensor.

★If the reading is within the standard, remove the ECU and check the wiring for continuity between main harness connectors.

**Special Tool - Hand Tester: 57001-1394**

○Disconnect the ECU and sensor connectors.

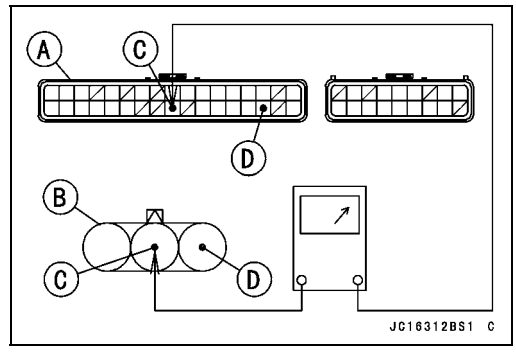
**Wiring Continuity Inspection**

**ECU Connector [A] ←→**

**Vehicle-down Sensor Connector [B]**

**BL/W lead (ECU terminal 26) [C]**

**BK/W lead (ECU terminal 32) [D]**

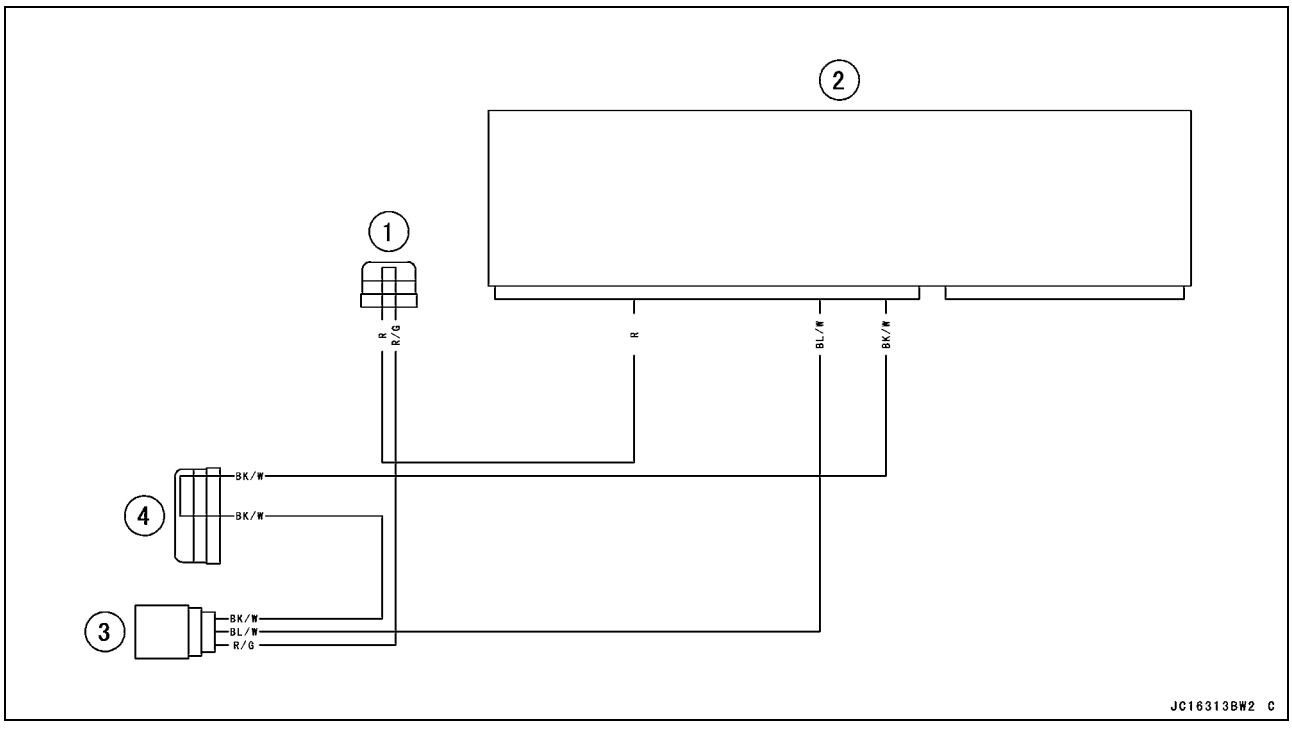



★If the wiring is good, check the ECU for its ground and power supply (see ECU Power Supply Inspection).

★If the ground and power supply are good, replace the ECU (see ECU Removal/Installation).

## Vehicle-down Sensor (Service Code/Character - 31/dOS)

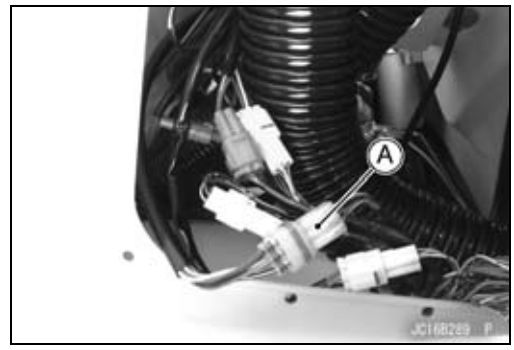
### Vehicle-down Sensor Circuit




1. Joint Connector F (5 V)
2. ECU
3. Vehicle-down Sensor
4. Joint Connector B (Ground)

## Immobilizer Amplifier (Service Code/Character - 35/Innb)

### *Amplifier Input Voltage Inspection*




**NOTE**

○*Be sure the battery is fully charged.*

- Remove the ignition key.
- Remove the ECU bracket (see Air Temperature Sensor (for Meter Unit) Removal/Installation in the Electrical System chapter).
- Connect a digital meter to the ignition switch connector [A] with needle adapter set.

**Special Tool - Needle Adapter Set: 57001-1457**

**Amplifier Input Voltage**
**Connections to Ignition Switch Connector:**
**Digital Meter (+) → R lead**
**Digital Meter (–) → BK lead**

- Measure the input voltage with the engine stopped and with the connector joined.
- Insert the ignition key in the ignition switch to turn it on.

**Input Voltage**
**Standard: Battery Voltage**

- Remove the ignition key.

★If the reading is out of the standard, check the wiring (see wiring diagram in next section).

**Special Tool - Hand Tester: 57001-1394**

★If the reading is within the standard, check the wiring to ECU (see wiring diagram in next section).

**Special Tool - Hand Tester: 57001-1394**

★If the wiring is good, replace the ignition switch (see Immobilizer System Parts Replacement in the Electrical System chapter).

## Blank Key Detection (Service Code/Character - 36/Ignl)

- This code appears in the following conditions.

○The transponder [A] in the FPO mode and/or SLO mode key is malfunction.

○When the spare key of unregistration is used.

- Therefore, the service code character "Ignl" will disappear when the above issue is solved.

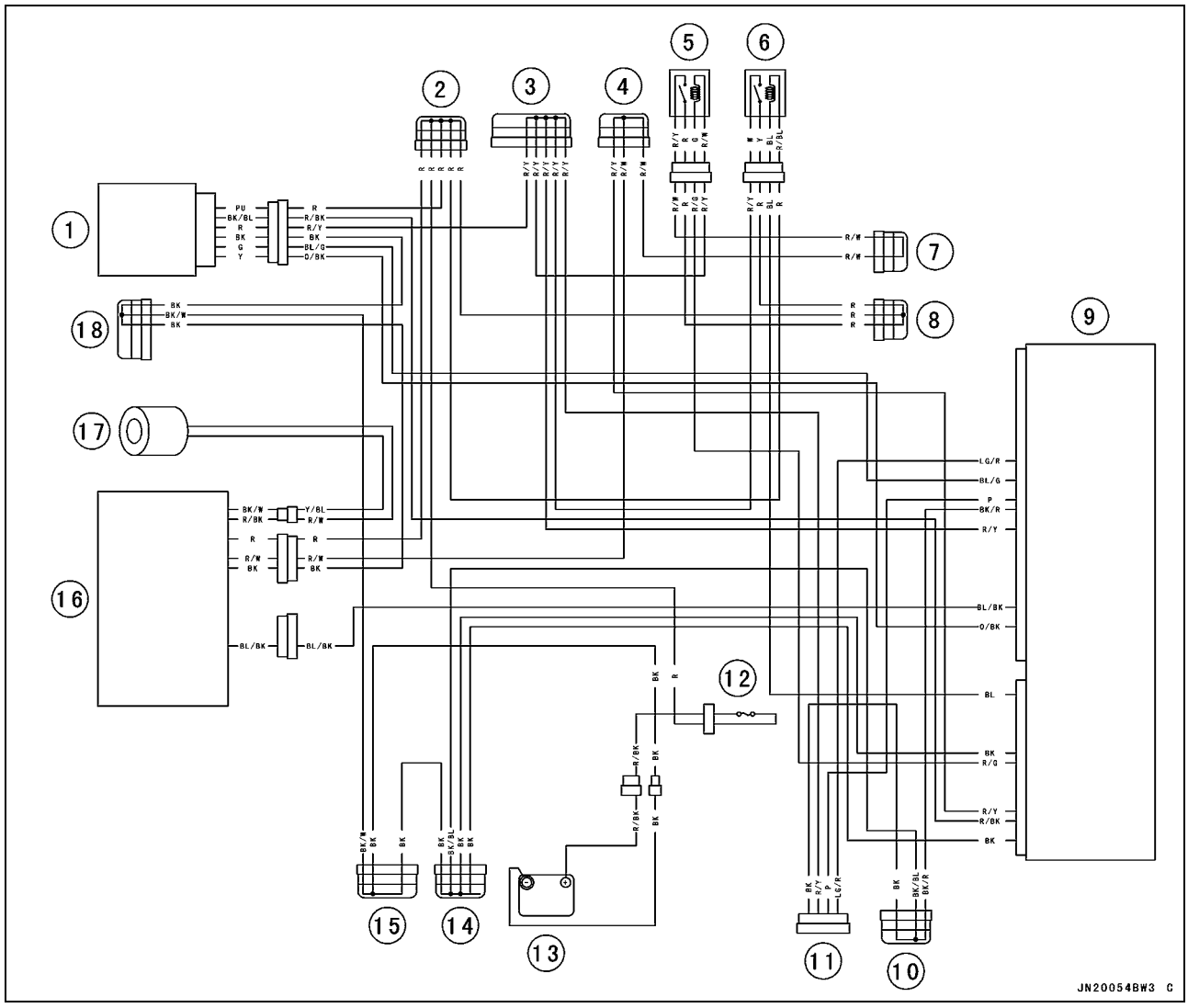
### *User Key Inspection*

- Register the user key correctly (see Key Registration in the Electrical System chapter).

★If the service code character "Ignl" appears again, the transponder in the key is malfunction, replace it.

## Blank Key Detection (Service Code/Character - 36/Ignl)

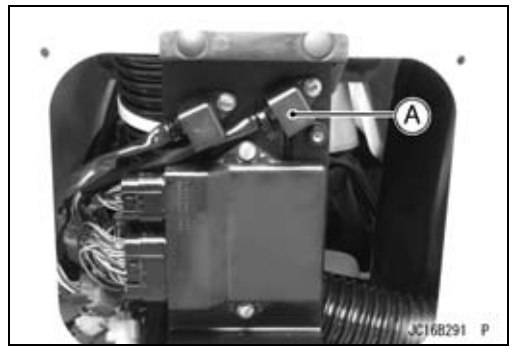
### Immobilizer System Circuit




1. Ignition Switch (Immobilizer Amplifier)
2. Joint Connector P (12 V)
3. Joint Connector R (12 V)
4. Joint Connector T (12 V)
5. ECU Main Relay
6. System Relay
7. Joint Connector D (12 V)
8. Joint Connector C (12 V)
9. ECU
10. Joint Connector E (Ground)
11. Immobilizer/Kawasaki Diagnostic System Connector
12. Main Fuse 20 A
13. Battery
14. Joint Connector Y (Ground)
15. Joint Connector S (Ground)
16. Meter Unit
17. Buzzer
18. Joint Connector Q (Ground)

## Fuel Pump Relay (Service Code/Character - 45, 46/F-P1, F-P2)

### *Fuel Pump Relay Removal/Installation*




- Refer to the Relay Assembly Removal/Installation in the Electrical System chapter.

Fuel Pump Relay [A]

### *Fuel Pump Relay Inspection*

- Refer to the Relay Assembly Inspection in the Electrical System chapter.

★If the fuel pump relay is normal, check the wiring for continuity (see wiring diagram in this section).

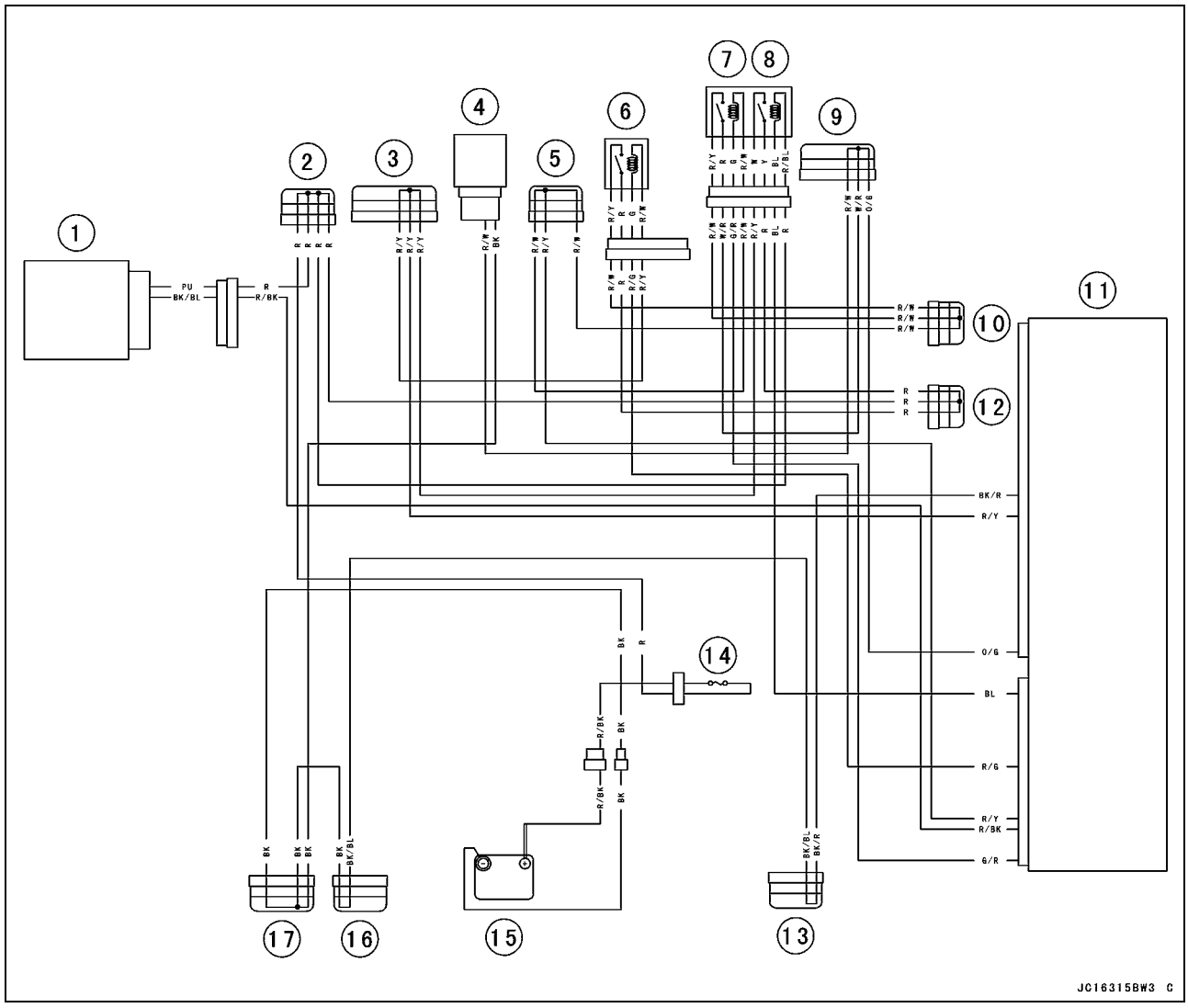
**Special Tool - Hand Tester: 57001-1394**

★If the wiring is good, check the ECU for its ground and power supply (see ECU Power Supply Inspection).

★If the ground and power supply are good, replace the ECU (see ECU Removal/Installation).

## Fuel Pump Relay (Service Code/Character - 45, 46/F-P1, F-P2)

### Fuel Pump Relay Circuit




1. Ignition Switch
2. Joint Connector P (12 V)
3. Joint Connector R (12 V)
4. Fuel Pump
5. Joint Connector T (12 V)
6. ECU Main Relay
7. Fuel Pump Relay
8. System Relay
9. Joint Connector L (12 V)
10. Joint Connector D (12 V)
11. ECU
12. Joint Connector C (12 V)
13. Joint Connector E (Ground)
14. Main Fuse 20 A
15. Battery
16. Joint Connector Y (Ground)
17. Joint Connector S (Ground)

## Ignition Coils (Service Code/Character - 51, 52/COL1, COL2)

Ignition Coil #1, #4: Service Code/Character - 51/COL1
Ignition Coil #2, #3: Service Code/Character - 52/COL2

### *Ignition Coil Removal/Installation*

- Refer to the Ignition Coil Removal/Installation in the Electrical System chapter.

### *Ignition Coil Primary Winding Resistance Inspection*

- Refer to the Ignition Coil Inspection in the Electrical System chapter.

★If the reading is within the standard, check the input voltage (see Ignition Coil Input Voltage Inspection).

### *Ignition Coil Input Voltage Inspection*

**NOTE**

○*Be sure the battery is fully charged.*

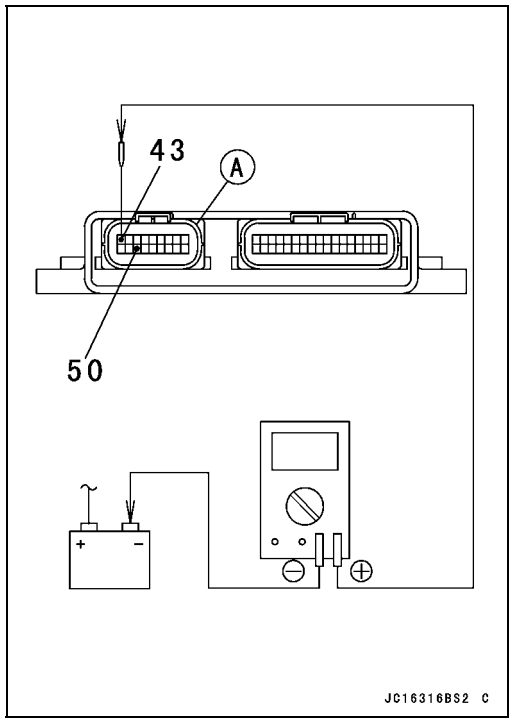
- Remove the ignition key.
- Remove the ECU (see ECU Removal).

○Do not disconnect the ECU connectors.

- Connect the digital meter to the connector [A] with the needle adapter set.

**Special Tool - Needle Adapter Set: 57001-1457**

**Ignition Coil Input Voltage**
**Connections to ECU Connector:**
**For Ignition Coil #1, #4**
**Digital Meter (+) → G/BL lead (terminal 43)**
**Digital Meter (–) → Battery (–) terminal**
**For Ignition Coil #2, #3**
**Digital Meter (+) → G lead (terminal 50)**
**Digital Meter (–) → Battery (–) terminal**




- Measure the input voltage to each primary winding of the ignition coils with the engine stopped and with the connectors joined.
- Insert the ignition key in the ignition switch to turn it on.

**Input Voltage**
**Standard: About Battery Voltage**

- Remove the ignition key.
- If the input voltage is within the standard, replace the ECU (see ECU Removal/Installation).

★If the input voltage is out of the standard, check the wiring for continuity (see wiring diagram in this section).

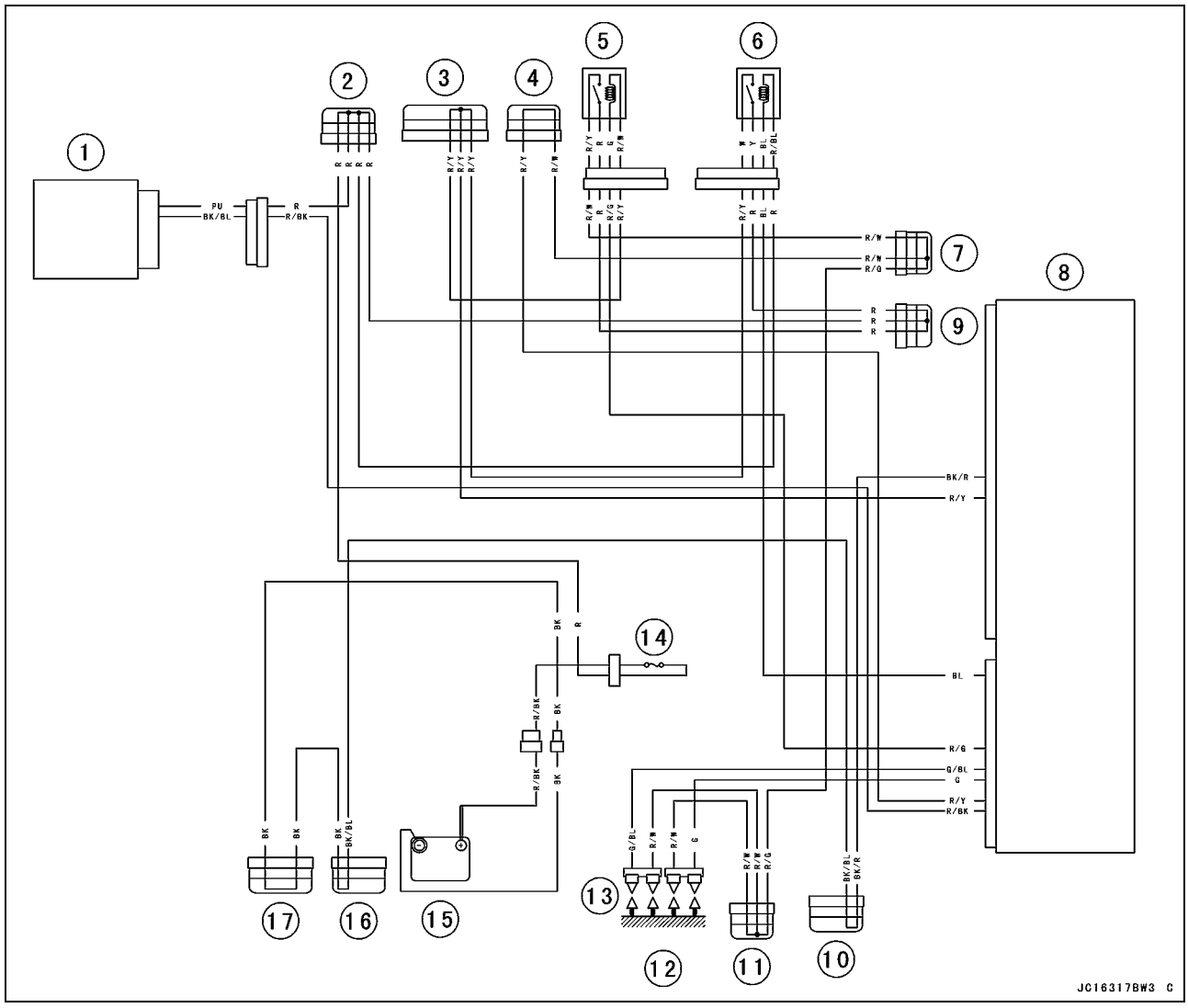
**Special Tool - Hand Tester: 57001-1394**

★If the wiring is good, replace the ECU (see ECU Removal/Installation).

★If the wiring is not good, replace the main harness.

## Ignition Coils (Service Code/Character - 51, 52/COL1, COL2)

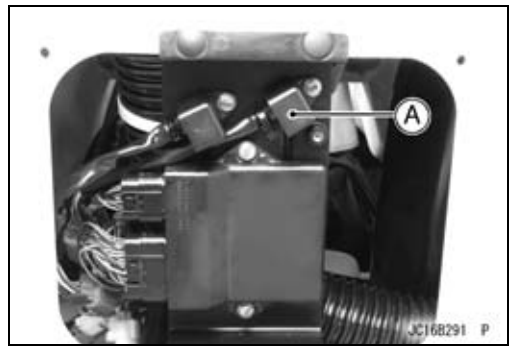
### Ignition Coil Circuit




1. Ignition Switch
2. Joint Connector P (12 V)
3. Joint Connector R (12 V)
4. Joint Connector T (12 V)
5. ECU Main Relay
6. System Relay
7. Joint Connector D (12 V)
8. ECU
9. Joint Connector C (12 V)
10. Joint Connector E (Ground)
11. Joint Connector M (12 V)
12. Spark Plugs
13. Ignition Coils
14. Main Fuse 20 A
15. Battery
16. Joint Connector Y (Ground)
17. Joint Connector S (Ground)

## System Relay (Service Code/Character - 57/rEL2)

### *System Relay Removal/Installation*




- Refer to the Relay Assembly Removal/Installation in the Electrical System chapter.

System Relay [A]

### *System Relay Inspection*

- Refer to the Relay Assembly Inspection in the Electrical System chapter.

★If the system relay is normal, check the wiring for continuity (see wiring diagram in this section).

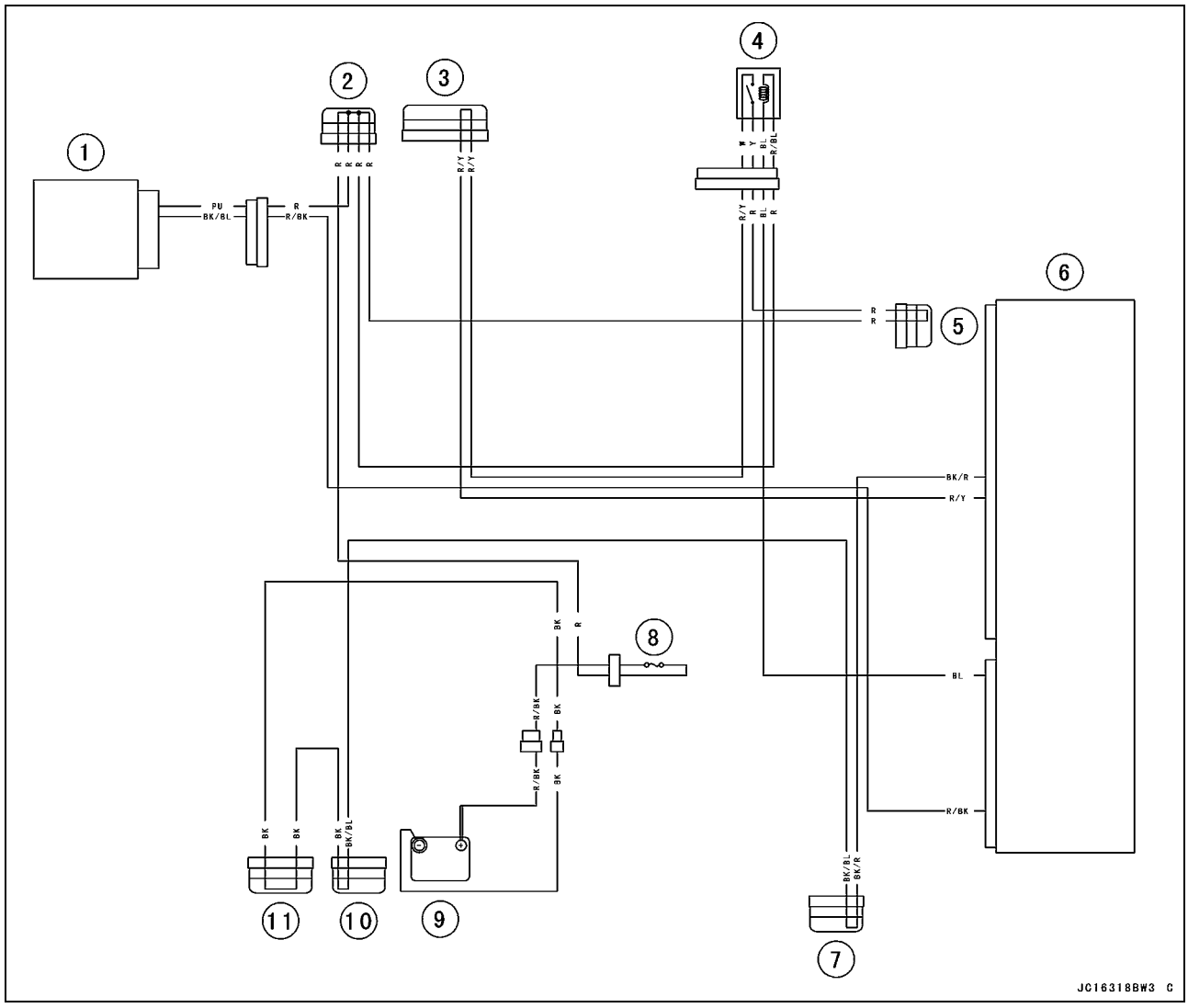
**Special Tool - Hand Tester: 57001-1394**

★If the wiring is good, check the ECU for its ground and power supply (see ECU Power Supply Inspection).

★If the ground and power supply are good, replace the ECU (see ECU Removal/Installation).

## System Relay (Service Code/Character - 57/rEL2)

### System Relay Circuit




1. Ignition Switch
2. Joint Connector P (12 V)
3. Joint Connector R (12 V)
4. System Relay
5. Joint Connector C (12 V)
6. ECU
7. Joint Connector E (Ground)
8. Main Fuse 20 A
9. Battery
10. Joint Connector Y (Ground)
11. Joint Connector S (Ground)

## Engine Overheating (Service Code/Character - 71/HEAt)

- If the service code character “HEAt” is displayed, check the doubtful parts referring to the following table.

| Possible Causes | Actions |
|---|---|
| Water passage clogged, loosened or damaged | Inspect (see chapter 9). |
| Incorrect engine oil level | Inspect (see chapter 4). |
| Engine oil poor quality or incorrect | Change (see chapter 4). |
| Water temperature sensor broken | Inspect (see chapters 3 and 14). |
| Jet pump or impeller damaged | Inspect (see chapter 11). |
| Oil cooler clogged | Clean (see chapter 4). |
| Carbon build-up on combustion chamber | Clean (see chapter 6). |

## Low Engine Oil Pressure (Service Code/Character - 72/OILP)

- If the service code character “OILP” is displayed, check the doubtful parts referring to the following table.

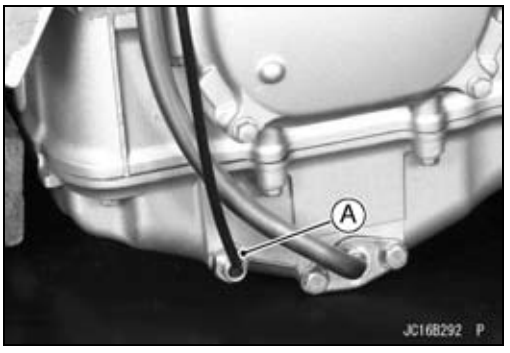
| Possible Causes | Actions |
|---|---|
| Oil leak | Inspect (see chapter 4). |
| Engine oil level too low | Inspect (see chapter 4). |
| Engine oil viscosity too low | Inspect (see chapter 4). |
| Oil filter clogged | Clean (see chapter 4). |
| Oil pressure switch damaged | Inspect (see chapters 3 and 14). |
| Oil cooler clogged | Inspect (see chapter 4). |
| Camshaft bearing worn | Inspect (see chapter 6). |
| Crankshaft bearing worn | Inspect (see chapter 8). |
| Oil pressure relief valve stuck open | Change (see chapter 4). |
| Oil pump damaged | Change (see chapter 4). |
| Oil screen clogged | Clean (see chapter 4). |
| O-ring at the oil passage in the crankcase damaged | Change (see chapter 4). |

## Oil Temperature Sensor (Service Code/Character - 73/OILt)

### *Oil Temperature Sensor Removal/Installation*

**NOTICE**

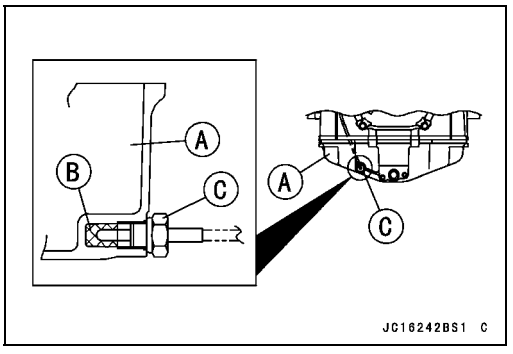
**A shock to the oil temperature sensor can damage it. Do not drop the oil temperature sensor.**




- Remove:
  Engine (see Engine Removal in the Engine Removal/Installation chapter)
  Oil Temperature Sensor [A]

- Fill the hollow of the oil pan [A] with heat transfer grease [B] to 80% volume as shown in the figure, before installing the oil temperature sensor [C].

**Heat Transfer Grease -**
**Heat Transfer Grease, SCH-20: 92137-1002 or equivalent**




**NOTICE**

**Overfilling the grease may damage the fitting boss. Do not overfill with grease.**

- Tighten:

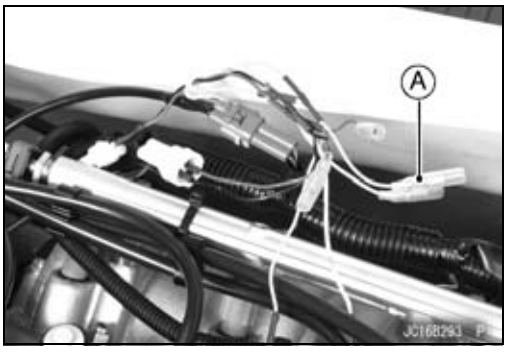
**Torque - Oil Temperature Sensor: 15 N·m (1.5 kgf·m, 11 ft·lb)**

### *Oil Temperature Sensor Output Voltage Inspection*

**NOTE**

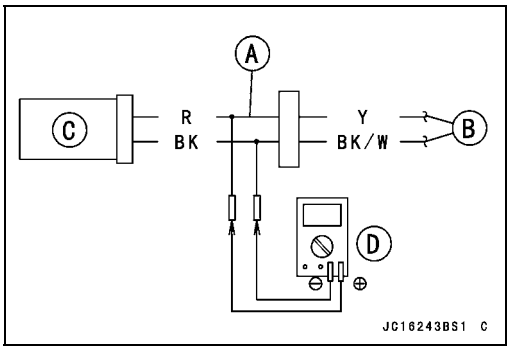
○*Be sure the battery is fully charged.*

- Remove the ignition key.
- Remove the seats (see Seat Removal in the Hull/Engine Hood chapter).
- Disconnect the oil temperature sensor connector and connect the measuring adapter [A] between these connectors as shown in the figure.
  Main Harness [B]
  Oil Temperature Sensor [C]




**Special Tool - Measuring Adapter: 57001-1700**

- Connect a digital meter [D] to the measuring adapter leads.




**Oil Temperature Sensor Output Voltage**
**Connections to Adapter:**
**Digital Meter (+) → R (sensor Y) lead**
**Digital Meter (–) → BK (sensor BK/W) lead**

- Measure the output voltage with the engine stopped and the connector joined.
- Insert the ignition key in the ignition switch to turn it on.

**Output Voltage**
**Standard: About DC 3.5 ~ 4.0 V at 20°C (68°F)**

**NOTE**

○*The output voltage changes according to the oil temperature in the engine.*

## Oil Temperature Sensor (Service Code/Character - 73/OILt)

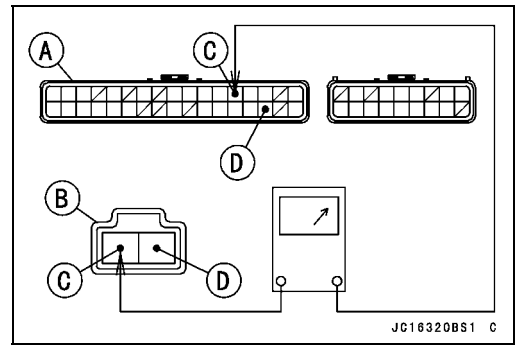
● Remove the ignition key.
★If the reading is within the standard, check the ECU for its ground and power supply (see ECU Power Supply Inspection).
★If the ground and power supply are good, replace the ECU (see ECU Removal/Installation).

★If the reading is out of the standard, remove the ECU and check the wiring for continuity between main harness connectors.

**Special Tool - Hand Tester: 57001-1394**

○Disconnect the ECU and sensor connectors.

**Wiring Continuity Inspection**
**ECU Connector [A] ←→**
**Oil Temperature Sensor Connector [B]**
**Y lead (ECU terminal 13) [C]**
**BK/W lead (ECU terminal 32) [D]**

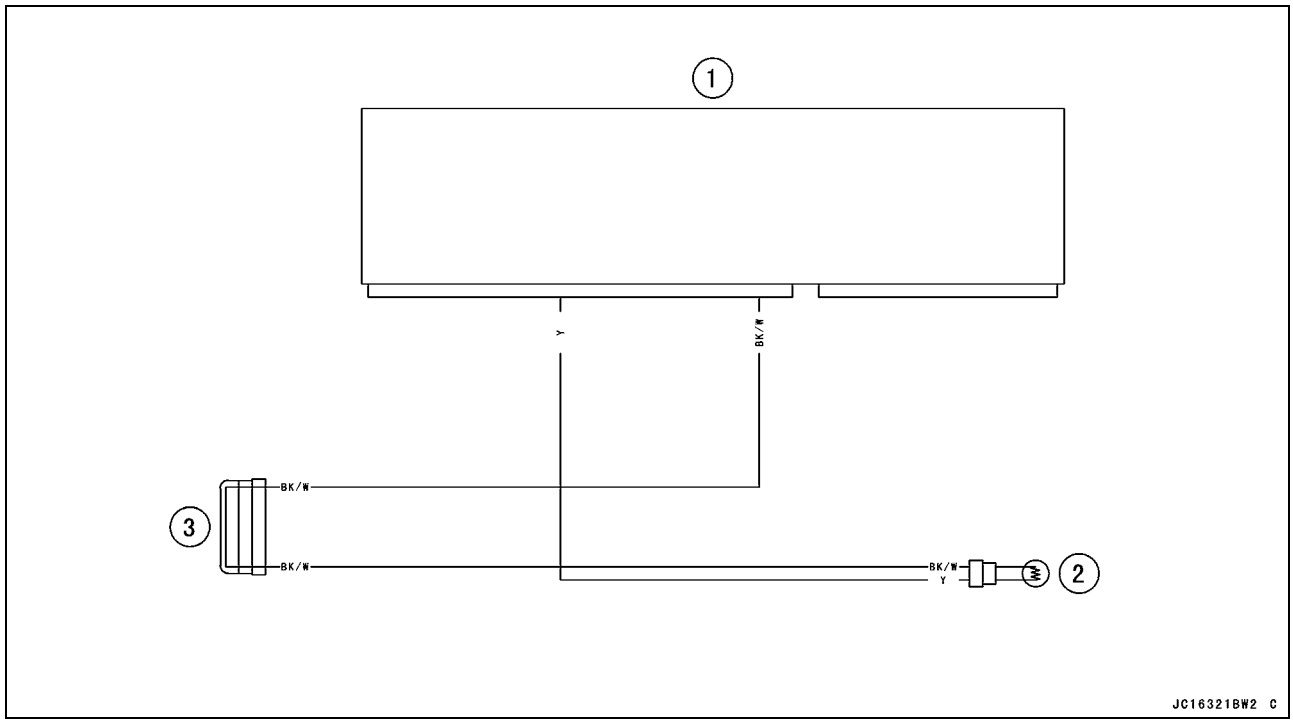



★If the wiring is good, check the oil temperature sensor resistance (see Oil Temperature Sensor Resistance Inspection).

### *Oil Temperature Sensor Resistance Inspection*

● Refer to the Oil Temperature Sensor Inspection in the Electrical System chapter.
★If the reading is within the standard, but the problem still exists, replace the ECU (see ECU Removal/Installation).

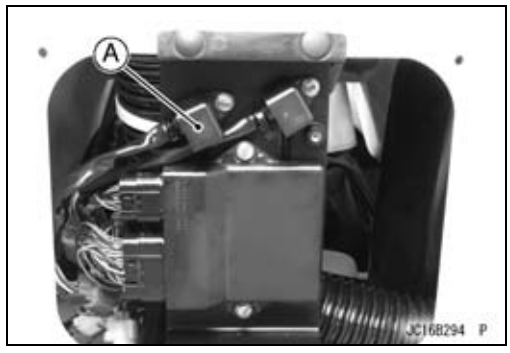
### Oil Temperature Sensor Circuit




1. ECU
2. Oil Temperature Sensor
3. Joint Connector B (Ground)

## ECU Main Relay (Service Code/Character - 75/rEL)

### *ECU Main Relay Removal/Installation*




- Refer to the Relay Assembly Removal/Installation in the Electrical System chapter.

ECU Main Relay [A]

### *ECU Main Relay Inspection*

- Refer to the Relay Assembly Inspection in the Electrical System chapter.

★If the ECU main relay is normal, check the wiring for continuity (see wiring diagram in this section).

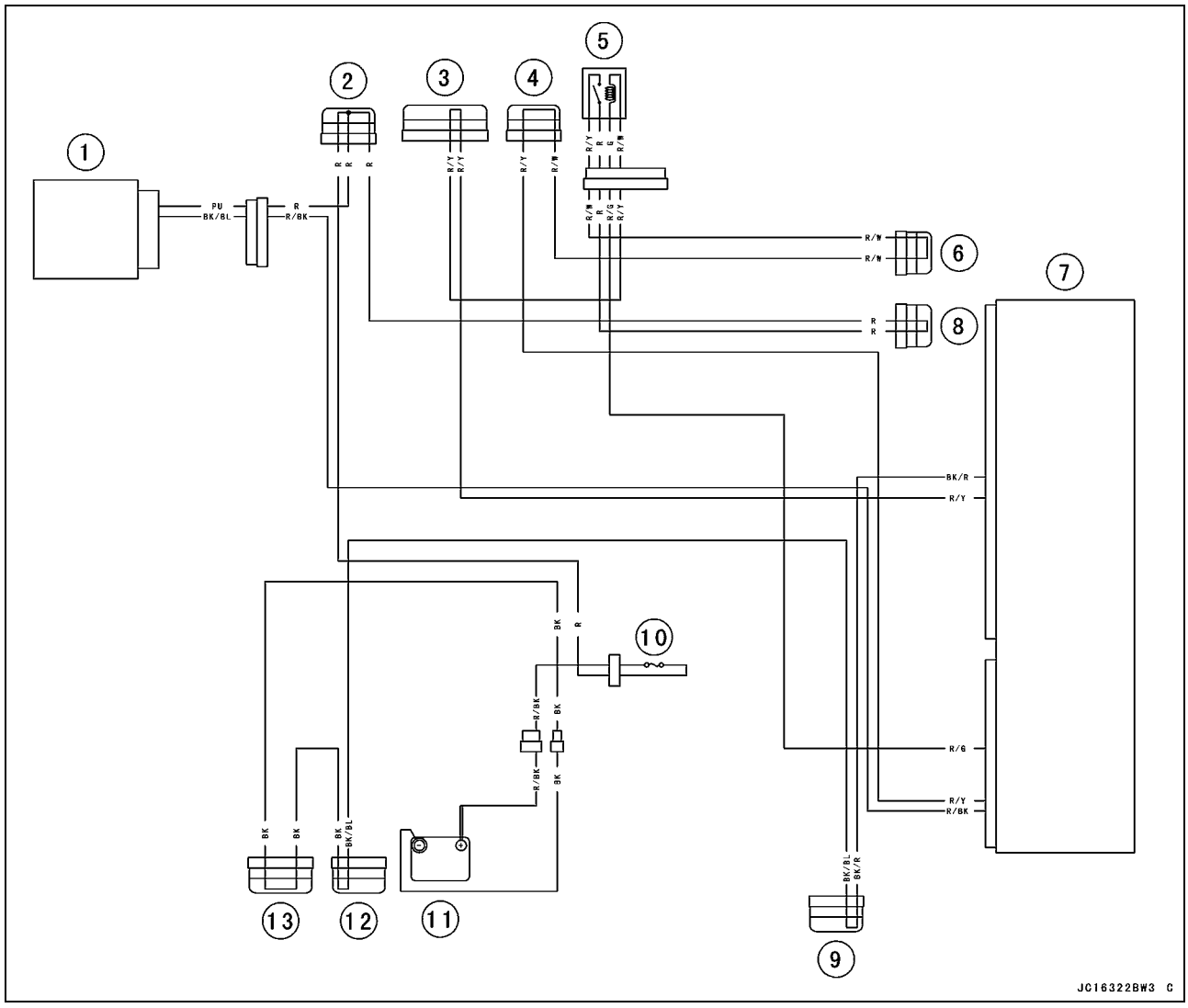
**Special Tool - Hand Tester: 57001-1394**

★If the wiring is good, check the ECU for its ground and power supply (see ECU Power Supply Inspection).

★If the ground and power supply are good, replace the ECU (see ECU Removal/Installation).

## ECU Main Relay (Service Code/Character - 75/rEL)

### ECU Main Relay Circuit




1. Ignition Switch
2. Joint Connector P (12 V)
3. Joint Connector R (12 V)
4. Joint Connector T (12 V)
5. ECU Main Relay
6. Joint Connector D (12 V)
7. ECU
8. Joint Connector C (12 V)
9. Joint Connector E (Ground)
10. Main Fuse 20 A
11. Battery
12. Joint Connector Y (Ground)
13. Joint Connector S (Ground)

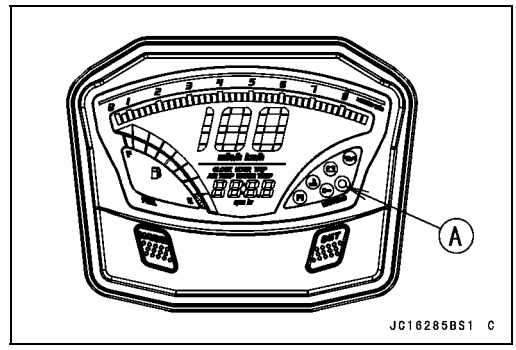
## Engine Oil Overheating (Service Code/Character - 76/OILH)

- If the service code character “OILH” is displayed, check the doubtful parts referring to the following table.

| Possible Causes | Actions |
|---|---|
| Incorrect engine oil level | Inspect (see chapter 4). |
| Engine oil poor quality or incorrect | Change (see chapter 4). |
| Oil temperature sensor broken | Inspect (see chapters 3 and 14). |
| Oil cooler clogged | Clean (see chapter 4). |
| Oil pump malfunction | Inspect (see chapter 4). |
| Relief valve malfunction | Inspect (see chapter 4). |
| Water passage clogged, loosened or damaged | Inspect (see chapter 9). |
| Weeds or debris in jet pump | Inspect (see chapter 11). |

## Red Warning Indicator Light (LED)

### *Light (LED) Inspection*

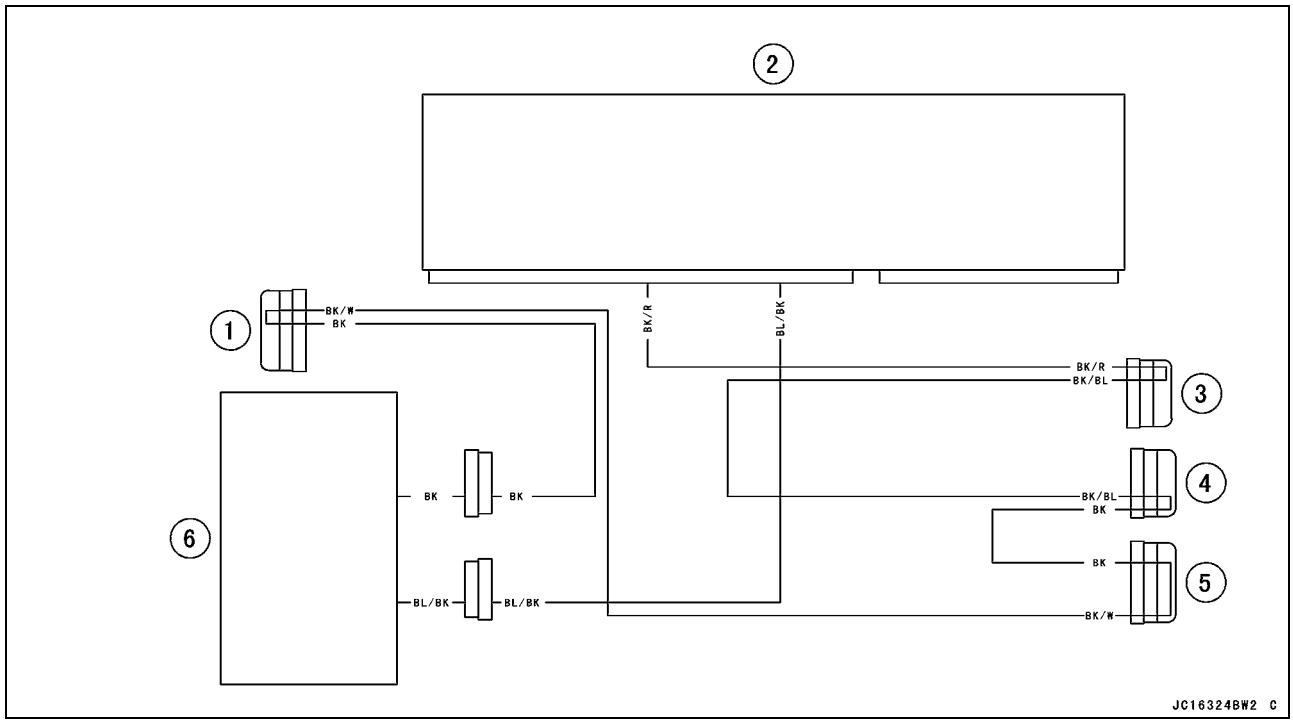



The red warning indicator light (LED) [A] is used for the following warnings.

Fuel Level
Low Battery Voltage
Engine Cooling Water Temperature
Engine Oil Pressure
Oil Temperature Sensor
Engine Oil Overheat
FI
Immobilizer

- Refer to the Meter Unit Operation Inspection in the Electrical System chapter.

### Red Warning Indicator Light (LED) (FI/Immobilizer) Circuit




1. Joint Connector Q (Ground)
2. ECU
3. Joint Connector E (Ground)
4. Joint Connector Y (Ground)
5. Joint Connector S (Ground)
6. Meter Unit

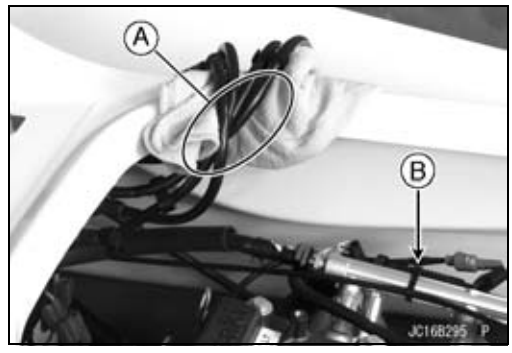
## Fuel Injectors

### *Fuel Injector Removal*

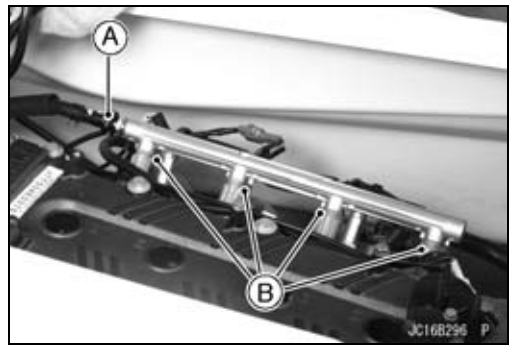
**⚠ WARNING**

**Gasoline is extremely flammable and can be explosive under certain conditions, creating the potential for serious burns. Make sure the area is well ventilated and free from any source of flame or sparks; this includes any appliance with a pilot light. Do not smoke. Remove the ignition key. Disconnect the battery (–) terminal. To avoid fuel spills, draw it from the tank when the engine is cold. Be prepared for fuel spillage; any spilled fuel must be completely wiped up immediately.**

- Remove the seats (see Seat Removal in the Hull/Engine Hood chapter).
- Remove the spark plug leads and place them [A] out of the engine compartment.
- Cut the band [B].



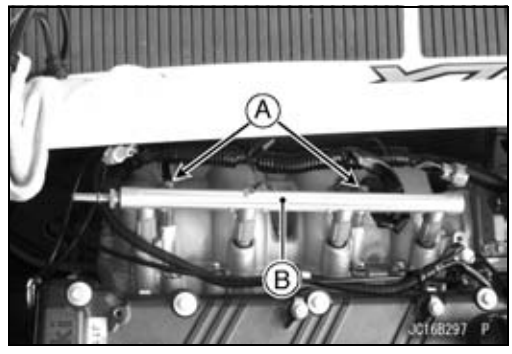

- Disconnect:
  Fuel Hose [A] (see Fuel Hose Removal)
  Fuel Injector Connectors [B]




- Remove the bolts [A] and collars to pull out the fuel injectors from the intake manifold together with the delivery pipe assy [B].

**NOTE**

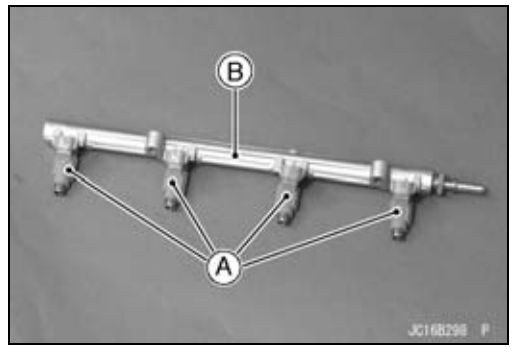
○*Do not damage the insertion portions of the injectors when they are pulled out from the intake manifold.*




- Pull out the fuel injectors [A] from the delivery pipe assy [B].

**NOTE**

○*Do not damage the insertion portions of the injectors when they are pulled out from the delivery pipe assy.*




***NOTICE***

**A shock to the fuel injector can damage it. Do not drop the fuel injector.**

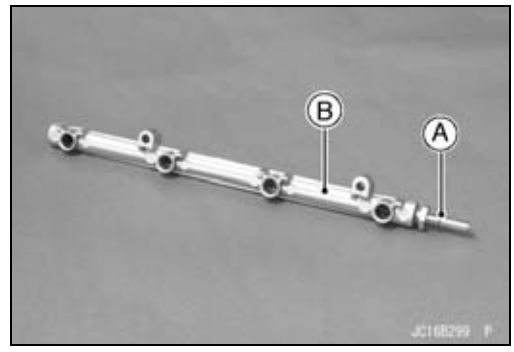
## Fuel Injectors

### *Fuel Injector Installation*

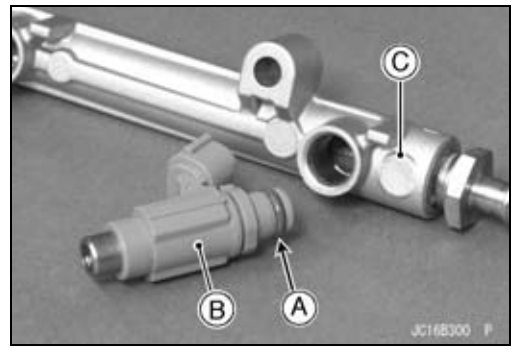
- Before installation, blow away dirt or dust from the intake manifold and delivery pipe assy by applying compressed air.

- Apply a non-permanent locking agent to the threads of the fitting [A].
- Tighten the fitting to the delivery pipe [B].

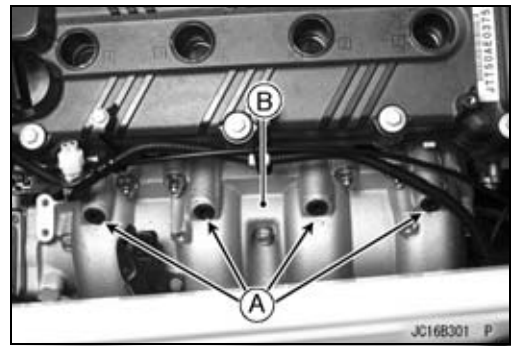
**Torque - Delivery Pipe Fitting: 20 N·m (2.0 kgf·m, 15 ft·lb)**




- Replace the O-rings [A] of each fuel injector [B] with new ones.
- Apply grease to the O-rings.
- Insert each fuel injectors to the delivery pipe assy [C] and confirm whether the injectors turn smoothly or not.

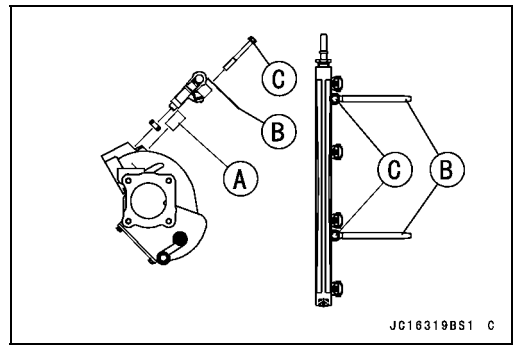



- Replace the dust seals [A] with new ones.
- Apply grease to the inside and outside of dust seals.
- Insert the new dust seals to the intake manifold [B].




- Install the fuel injectors along with the delivery pipe assy to the intake manifold.
- Install the collars [A], clamps [B] and bolts [C] as shown in the figure.
- Tighten:

**Torque - Delivery Pipe Assy Mounting Bolts: 7.8 N·m (0.80 kgf·m, 69 in·lb)**




- Run the hoses, leads and harness correctly (see Cable, Wire, and Hose Routing section in the Appendix chapter).
- Install the removed parts (see appropriate chapters).

### *Fuel Injector Audible Inspection*

**NOTE**

○*Be sure the battery is fully charged.*

- Remove the seats (see Seat Removal in the Hull/Engine Hood chapter).

## Fuel Injectors

- Start the engine.
- Apply the tip of a screwdriver [A] to the fuel injector [B]. Put the grip end onto your ear, and listen whether the fuel injector is clicking or not.

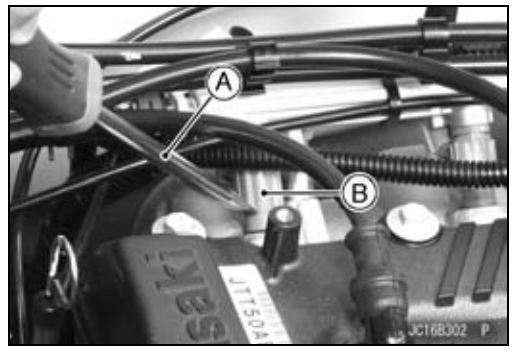
○A sound scope can also be used.
○The click interval becomes shorter as the engine speed rises.

- Do the same for the other fuel injectors.

★If all the fuel injectors click at a regular intervals, the fuel injectors are normal.

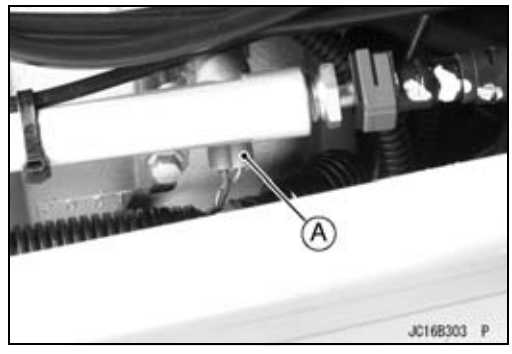
- Remove the ignition key.

★If any fuel injector does not click, check the fuel injector resistance (see Fuel Injector Resistance Inspection).




### *Fuel Injector Resistance Inspection*

- Remove the seats (see Seat Removal in the Hull/Engine Hood chapter).
- Disconnect the fuel injector connector [A].

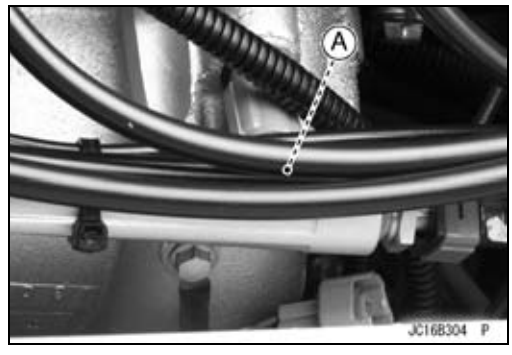



- Connect a digital meter to the terminals in each fuel injector [A].
- Measure the fuel injector resistance.

**Fuel Injector Resistance**
**Standard: About 11.7 ~ 12.3 Ω at 20°C (68°F)**

★If the reading is out of the standard, replace the fuel injector.

★If the reading is within the standard, check the power source voltage (see Fuel Injector Power Source Voltage Inspection).

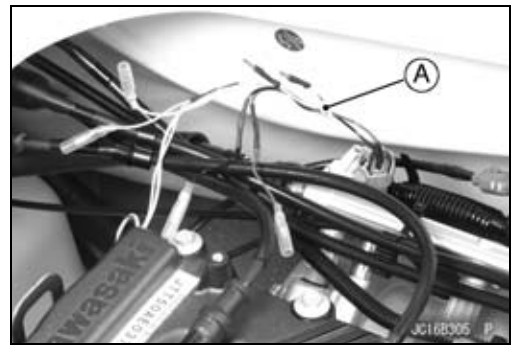


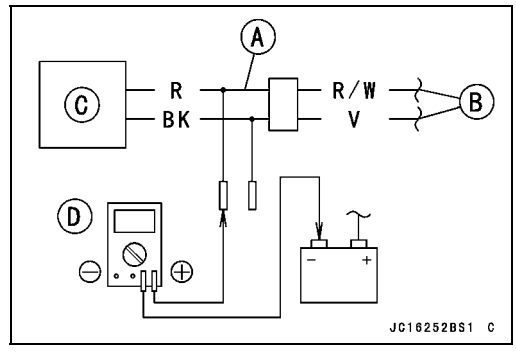
## Fuel Injectors

### *Fuel Injector Power Source Voltage Inspection*

**NOTE**

○*Be sure the battery is fully charged.*




- Remove the ignition key.
- Remove the seats (see Seat Removal in the Hull/Engine Hood chapter).
- Disconnect the injector connector and connect the measuring adapter [A] between these connectors as shown in the figure.
  Main Harness [B]
  Fuel Injector #1 [C]

**Special Tool - Measuring Adapter: 57001-1700**

- Connect a digital meter [D] to the measuring adapter lead.

**Fuel Injector Power Source Voltage**
**Connections to Adapter:**
**For Fuel Injector #1, #2, #3, #4**
**Digital Meter (+) → R (injector R/W) lead**
**Digital Meter (–) → Battery (–) terminal**

- Measure the power source voltage with the engine stopped.
- Insert the ignition key in the ignition switch to turn it on.

**Power Source Voltage**
**Standard: Battery Voltage for 3 seconds, and then 0 V**

- Remove the ignition key.

★If the reading stays on battery voltage and never shows 0 V, check the fuel pump relay (see Relay Assembly Inspection in the Electrical System chapter).

★If the fuel pump relay is normal, check the ECU for its ground and power supply (see ECU Power Supply Inspection).

★If the ground and power supply are good, replace the ECU (see ECU Removal/Installation).

★If there is still no battery voltage, check the fuel pump relay (see Relay Assembly Inspection in the Electrical System chapter).

★If the fuel pump relay is normal, check the power source wiring (see Fuel Injector Circuit).

**Special Tool - Hand Tester: 57001-1394**

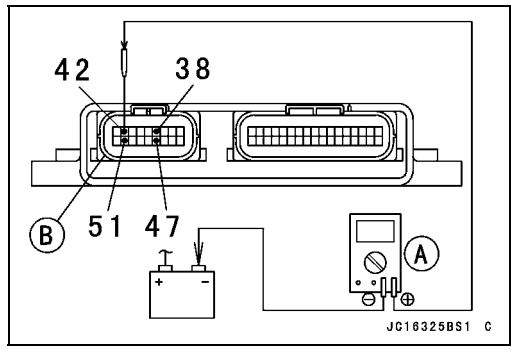
★If the wiring is good, check the ECU for its ground and power supply (see ECU Power Supply Inspection).

★If the ground and power supply are good, replace the ECU (see ECU Removal/Installation).

★If the reading is in specification, check the output voltage (see Fuel Injector Output Voltage Inspection).

## Fuel Injectors

### *Fuel Injector Output Voltage Inspection*




**NOTE**

○*Be sure the battery is fully charged.*

- Remove the ignition key.
- Remove the ECU (see ECU Removal).

○Do not disconnect the ECU connector.

- Connect a digital meter [A] to the connector [B] with the needle adapter set.

**Special Tool - Needle Adapter Set: 57001-1457**

**Fuel Injector Output Voltage**
**Connections to ECU Connector:**
**For Fuel Injector #1**
**Digital Meter (+) → V lead (ECU terminal 42)**
**Digital Meter (–) → Battery (–) terminal**
**For Fuel Injector #2**
**Digital Meter (+) → O lead (ECU terminal 51)**
**Digital Meter (–) → Battery (–) terminal**
**For Fuel Injector #3**
**Digital Meter (+) → BR lead (ECU terminal 38)**
**Digital Meter (–) → Battery (–) terminal**
**For Fuel Injector #4**
**Digital Meter (+) → BL/Y lead (ECU terminal 47)**
**Digital Meter (–) → Battery (–) terminal**

- Measure the output voltage with the engine stopped and with the connector joined.
- Insert the ignition key in the ignition switch to turn it on.

**Output Voltage**
**Standard: Battery Voltage for 3 seconds, and then 0 V**

- Remove the ignition key.

★If the reading is in specification, check the ECU for its ground and power supply (see ECU Power Supply Inspection).

★If the ground and power supply are good, replace the ECU (see ECU Removal/Installation).

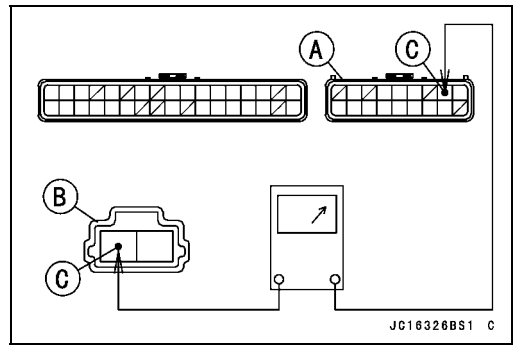
## Fuel Injectors

★If the reading is out of the specification, remove the ECU and check the wiring for continuity between main harness connectors.

**Special Tool - Hand Tester: 57001-1394**

○Disconnect the ECU and injector connectors.

**Wiring Continuity Inspection**
**ECU Connector [A] ←→ Fuel Injector Connector [B]**
**For Fuel Injector #1**
**V lead (ECU terminal 42) [C]**
**For Fuel Injector #2**
**O lead (ECU terminal 51)**
**For Fuel Injector #3**
**BR lead (ECU terminal 38)**
**For Fuel Injector #4**
**BL/Y lead (ECU terminal 47)**

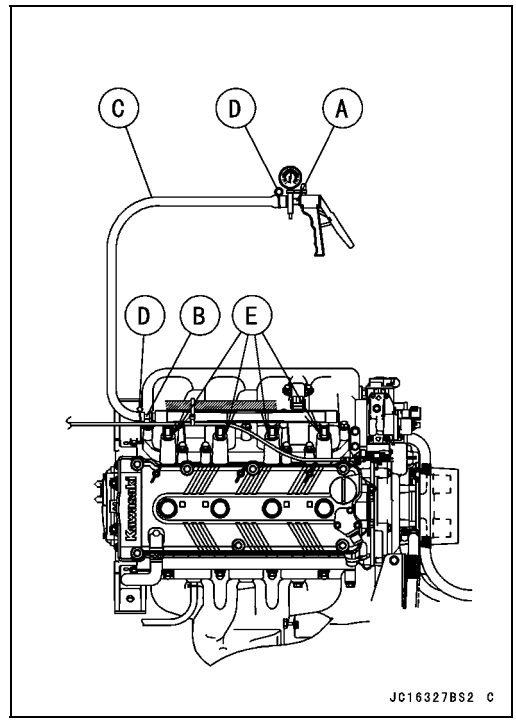



★If the wiring is good, check the ECU for its ground and power supply (see ECU Power Supply Inspection).
★If the ground and power supply are good, replace the ECU (see ECU Removal/Installation).

### *Fuel Injector Fuel Line Inspection*

● Remove:
Seats (see Seat Removal in the Hull/Engine Hood chapter)
Fuel Hose (see Fuel Hose Removal)
● Check the injector fuel line for leakage as follows.
○Connect a commercially available vacuum/pressure pump [A] to the nipple of the delivery pipe [B] with the fuel hose [C] (supply end with the clamps [D]) as shown in the figure.
○Apply soap and water solution to the areas [E] as shown in the figure.
○Watching the pressure gauge, squeeze the pump lever, and build up the pressure until the pressure reaches the maximum pressure.

**Injector Fuel Line Maximum Pressure**
**Standard: 300 kPa (3.06 kgf/cm², 43 psi)**



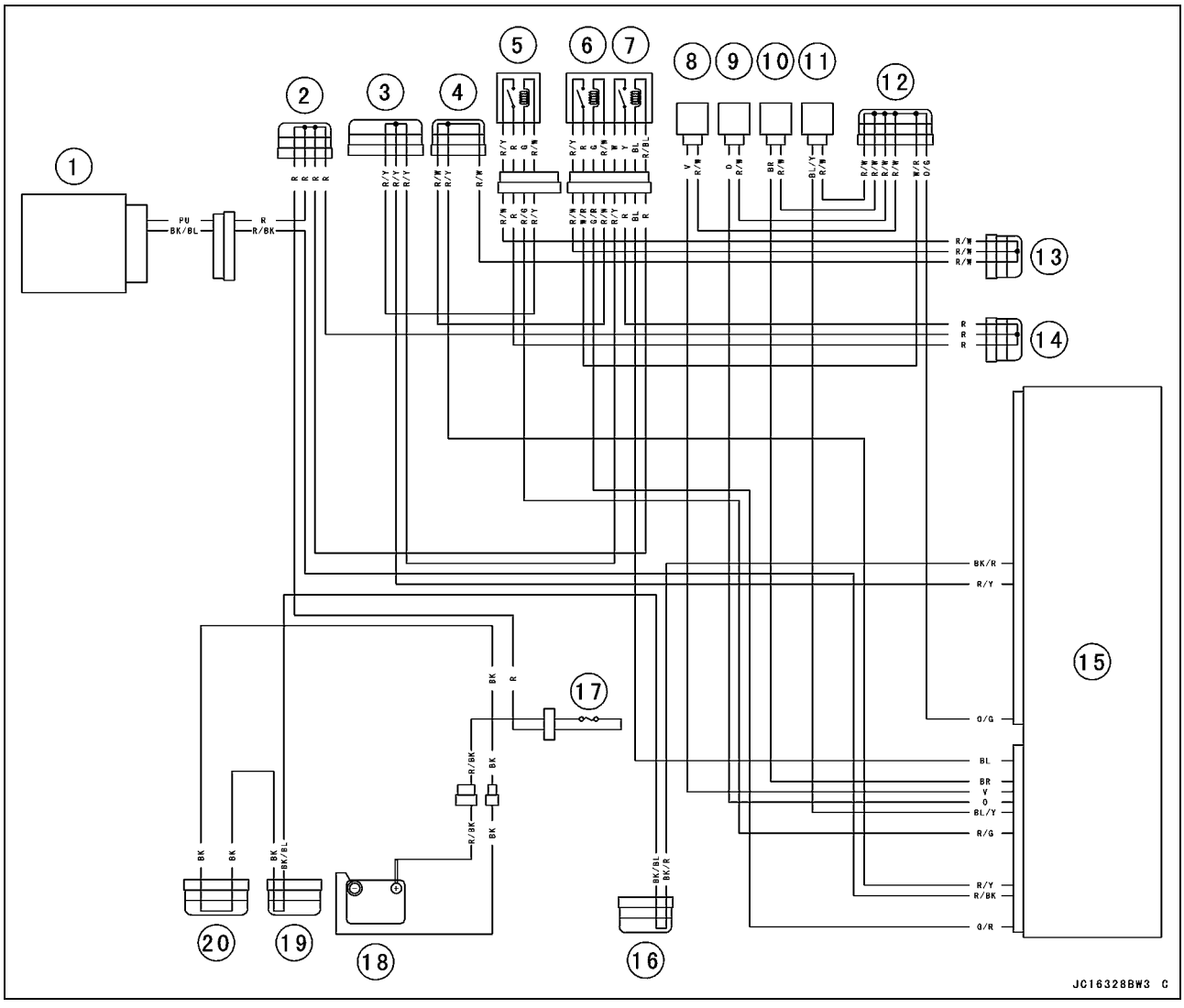

***NOTICE***

**High pressure could damage seals in the fuel line. Do not exceed the maximum pressure during pressure testing.**

○Watch the gauge for at least 6 seconds.
★If the pressure holds steady, the fuel line is good.
★If the pressure drops at once or if bubbles are found in the area, the fuel line is leaking. Replace the delivery pipe assy, injectors and related parts.
○Repeat the leak test, and check the fuel line for no leakage.
● Install the fuel hose (see Fuel Hose Installation).
● Start the engine and check for fuel leakage.

## Fuel Injectors

### Fuel Injector Circuit



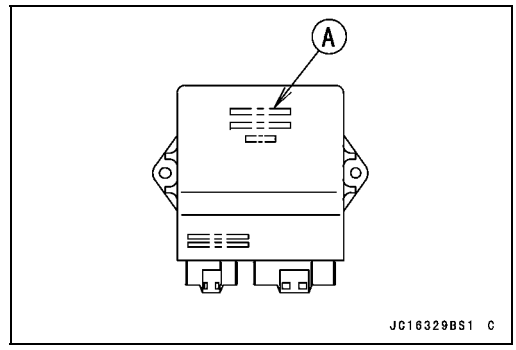

1. Ignition Switch
2. Joint Connector P (12 V)
3. Joint Connector R (12 V)
4. Joint Connector T (12 V)
5. ECU Main Relay
6. Fuel Pump Relay
7. System Relay
8. Fuel Injector #1
9. Fuel Injector #2
10. Fuel Injector #3
11. Fuel Injector #4
12. Joint Connector L (12 V)
13. Joint Connector D (12 V)
14. Joint Connector C (12 V)
15. ECU
16. Joint Connector E (Ground)
17. Main Fuse 20 A
18. Battery
19. Joint Connector Y (Ground)
20. Joint Connector S (Ground)

## ECU

### ECU Identification

○Most countries have their own regulations, so each ECU has different characteristic. So, do not confuse ECU with each other and use only the ECU for your model. Otherwise, the watercraft cannot clear the regulation.

| Model | Part Number [A] | Specification |
|---|---|---|
| JT1500K | 21175-0751 | US |
| | | AU |
| | 21175-0768 | EUR |

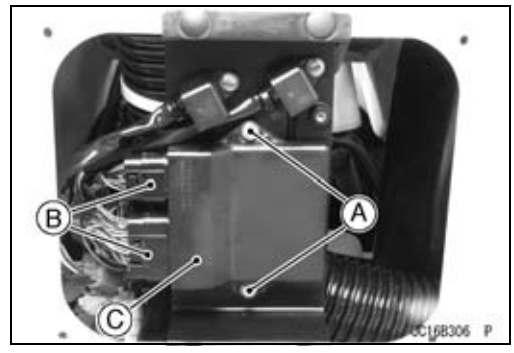



### ECU Removal

**NOTICE**

**A shock to the ECU can damage it. Do not drop the ECU.**

● Remove:
Front Access Cover (see Front Access Cover Removal/Installation in the Hull/Engine Hood chapter)
Mounting Bolts [A]
ECU Connectors [B]
ECU [C]




### ECU Installation

● Connect the ECU connectors and install it.
● Apply a non-permanent locking agent to the threads of the ECU mounting bolts, and tighten them.

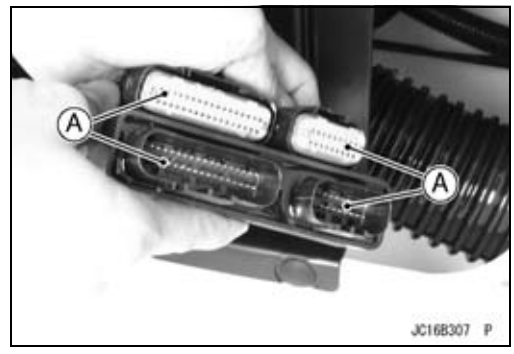
**Torque - ECU Mounting Bolts: 3.0 N·m (0.31 kgf·m, 27 in·lb)**

**NOTE**

○*After replacing the new ECU, be sure to register FPO key and SLO key (see Key Registration in the Electrical System chapter).*

### ECU Power Supply Inspection

● Remove the front access cover (see Front Access Cover Removal/Installation in the Hull/Engine Hood chapter).
● Visually inspect the ECU connectors.
★If the connector is clogged with mud or dust, blow it off with compressed air.
● Remove the ECU (see ECU Removal).
● Visually inspect the terminals [A] of the ECU connectors.
★If the terminals of the main harness connectors are damaged, replace the main harness.
★If the terminals of the ECU connectors are damaged, replace the ECU.



## ECU

- Remove the ignition key.
- Disconnect the ECU connectors [A].
- Set the hand tester [B] to the × 1 Ω range and check the following wiring for continuity.

**Special Tool - Hand Tester: 57001-1394**

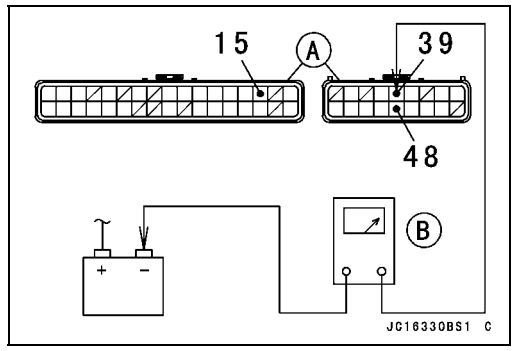
**ECU Grounding Inspection**
**Connections:**

| | | |
|---|---|---|
| **(I) BK leads (ECU terminal 39 or 48)** | ←→ | **Battery (–) Terminal** |
| **(II) BK/R lead (ECU terminal 15)** | ←→ | **Battery (–) Terminal** |
| **(III) Engine Ground** | ←→ | **Battery (–) Terminal** |

**Criteria:**

**Both: 0 Ω**

★If no continuity, check the connectors, the starter motor (–) cable for engine ground, or main harness, and repair or replace them if necessary.



## ECU

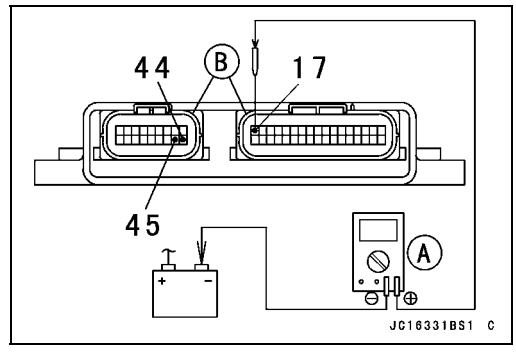
★If the wiring is good, check the power source voltage of the ECU.

**NOTE**

○*Be sure the battery is fully charged.*

- Connect the ECU connectors.
- Connect a digital meter [A] to the connectors [B] with the needle adapter set.

**Special Tool - Needle Adapter Set: 57001-1457**




**ECU Power Supply Inspection**

**Connections:**

**(I) Digital Meter (+) → Terminal 17 (R/Y)**

**Digital Meter (–) → Battery (–) terminal**

**(II) Digital Meter (+) → Terminal 44 (R/Y)**

**Digital Meter (–) → Battery (–) terminal**

**(III) Digital Meter (+) → Terminal 45 (R/BK)**

**Digital Meter (–) → Battery (–) terminal**

**Ignition Switch OFF:**

**Terminal 17 (R/Y): 0 V**

**Terminal 44 (R/Y): 0 V**

**Terminal 45 (R/BK): 0 V**

**Ignition Switch ON:**

**Terminal 17 (R/Y): Battery Voltage**

**Terminal 44 (R/Y): Battery Voltage**

**Terminal 45 (R/BK): Battery Voltage (while pushing ignition switch)**

★If the reading is out of the specification, check the following.

Main Fuse 20 A (see Fuse Inspection in the Electrical System chapter)

Ignition Switch (see Switch Inspection in the Electrical System chapter)

System Relay (see Relay Assembly Inspection in the Electrical System chapter)

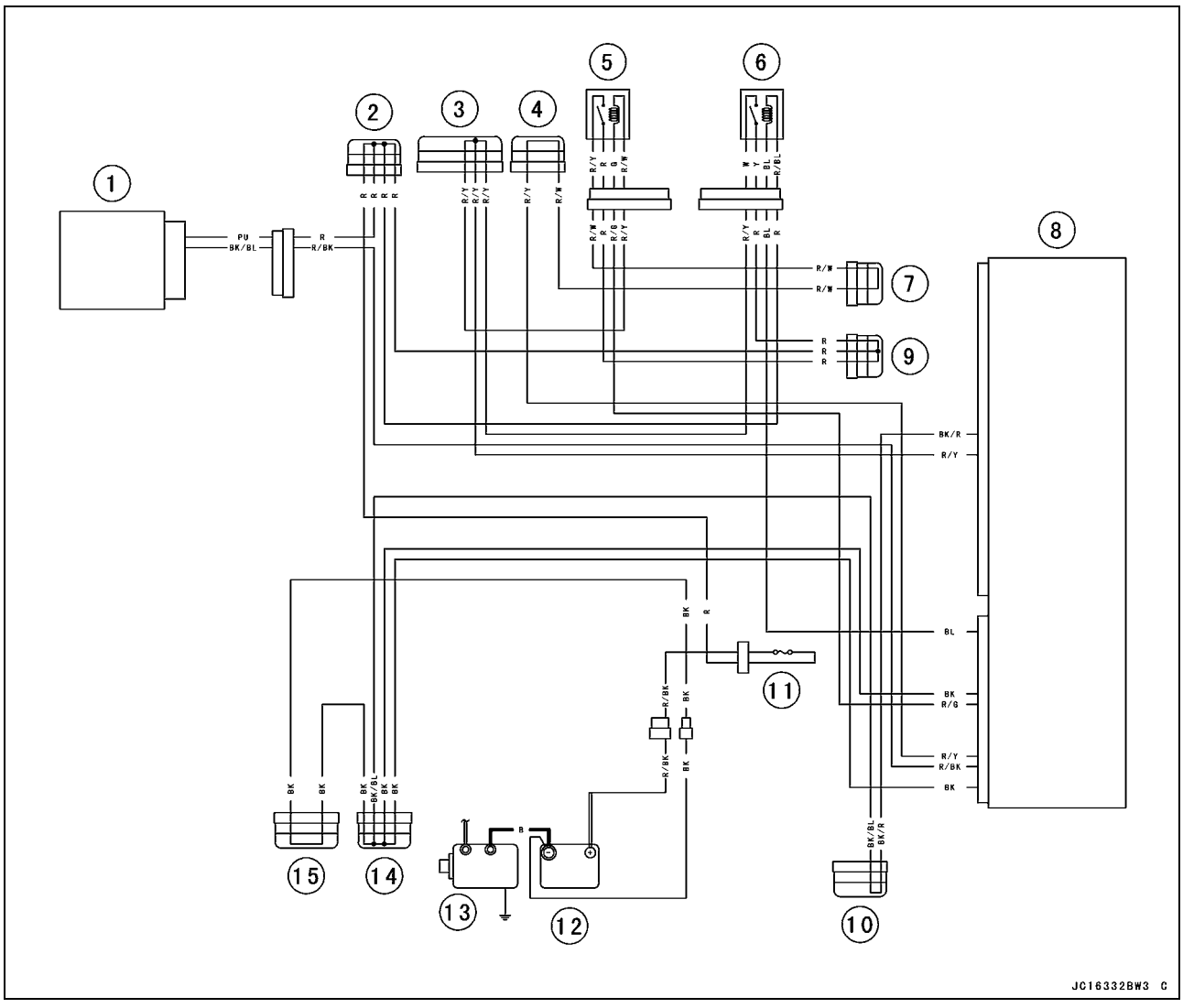
ECU Main Relay (see Relay Assembly Inspection in the Electrical System chapter)

Power Source Wiring (see wiring diagram in this section)

★If the fuse, ignition switch, relay and wiring are good, replace the ECU (see ECU Removal/Installation).

## ECU

### ECU Power Source Circuit




1. Ignition Switch
2. Joint Connector P (12 V)
3. Joint Connector R (12 V)
4. Joint Connector T (12 V)
5. ECU Main Relay
6. System Relay
7. Joint Connector D (12 V)
8. ECU
9. Joint Connector C (12 V)
10. Joint Connector E (Ground)
11. Main Fuse 20 A
12. Battery
13. Starter Motor
14. Joint Connector Y (Ground)
15. Joint Connector S (Ground)

## DFI Power Source

### *Main Fuse Removal*

- Refer to the Fuse Inspection in the Electrical System chapter.

### *Main Fuse Installation*

★If a fuse fails during operation, inspect the DFI system to determine the cause, and then replace it with a new fuse of proper amperage.

- Refer to the Fuse Inspection in the Electrical System chapter.

### *Main Fuse Inspection*

- Refer to the Fuse Inspection in the Electrical System chapter.

## Throttle Lever, Cable and Case

### *Free Play Inspection*

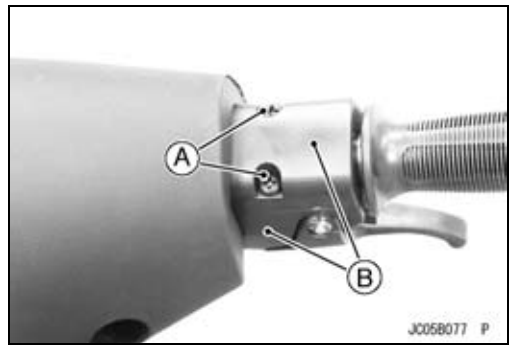
● Refer to the Throttle Control System Inspection in the Periodic Maintenance chapter.

### *Free Play Adjustment*

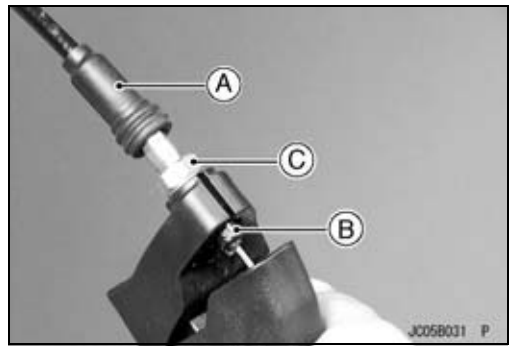
● Refer to the Throttle Control System Inspection in the Periodic Maintenance chapter.

### *Throttle Case Removal/Disassembly*

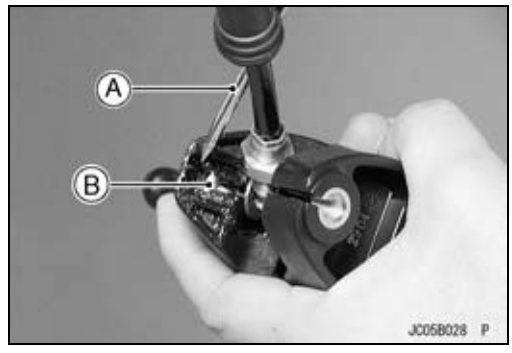
● Remove the handlebar pad (see Handlebar Removal in the Steering chapter).
● Remove the throttle case.
○Unscrew the throttle case mounting screws [A] separate the case halves [B].




● Remove the throttle cable from the case.
○Slide the rubber boot [A] and rubber cap [B] out of the place.
○Unscrew the throttle cable fitting nut [C].

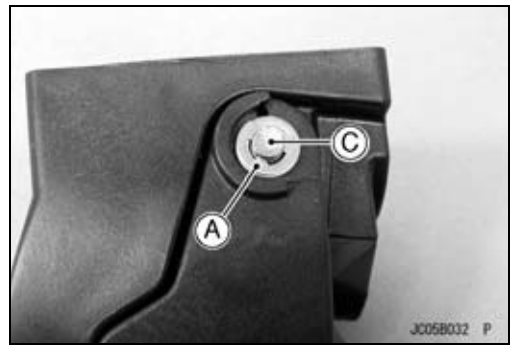


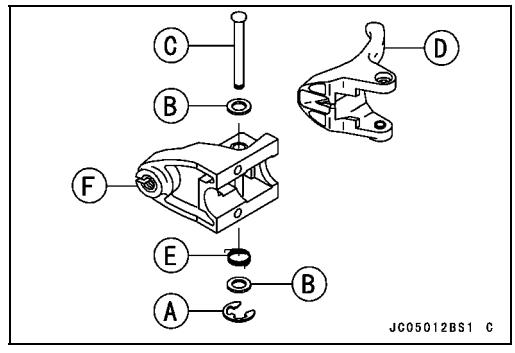

○Use a screwdriver [A] to separate the tip [B] of the cable end from the case body.



## Throttle Lever, Cable and Case

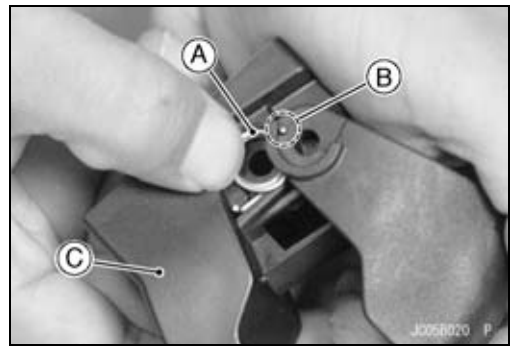
● Disassemble the throttle case.
○Remove the circlip [A], flat washers [B], pin [C], throttle lever [D] and return spring [E] from the case [F].



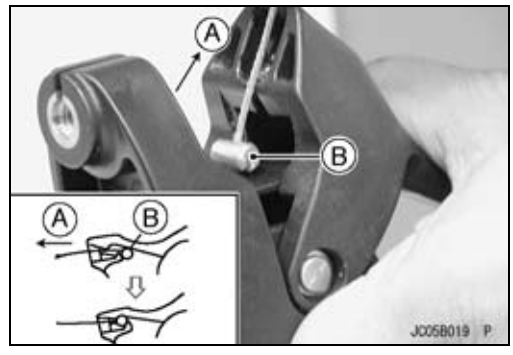




### *Throttle Case Assembly/Installation*

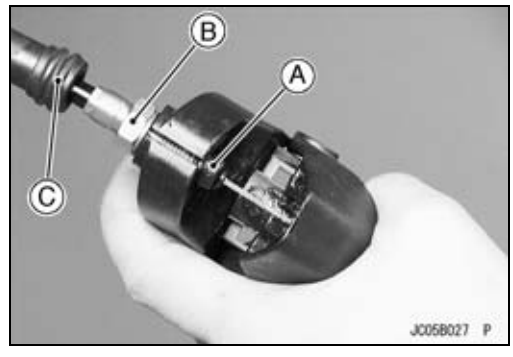
● Insert the end of the return spring [A] in the throttle lever hole [B] and set the spring in the throttle case [C] as shown in the figure.
● Install the throttle lever to the case.




● Lubricate the throttle cable before assembly/installation.
○Apply water-resistance grease to the tips of the throttle cable end.
● Pulling the throttle cable [A], set the tip [B] of the cable end as shown in the figure.
● Tighten the cable fitting nut.




● Be sure the rubber cap [A] is in place on the throttle cable fitting nut end.
● Cover the cable fitting nut [B] with the rubber boot [C].



## Throttle Lever, Cable and Case

● Tighten:

**Torque - Throttle Case Mounting Screws: 3.9 N·m (0.40 kgf·m, 35 in·lb)**

● Swing the throttle lever so that the throttle cable pulley is fully open.

**⚠ WARNING**

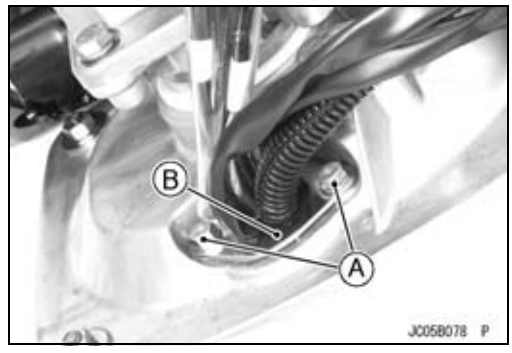
**Operation with an improperly assembled throttle case could result in an unsafe riding condition. Be sure the throttle case is assembled correctly.**

● Adjust the throttle cable (see Throttle Control System Inspection in the Periodic Maintenance chapter).

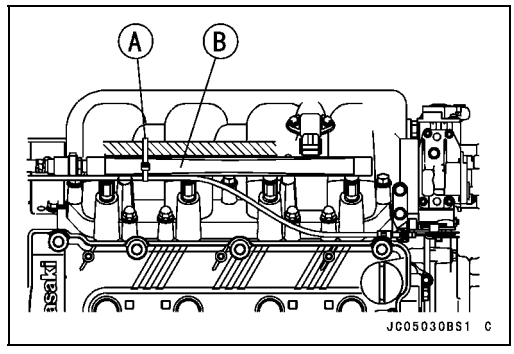
### *Throttle Cable Removal*

● Remove:
Seats (see Seat Removal in the Hull/Engine Hood chapter)
Throttle Cable Upper End (see Throttle Case Removal/Disassembly)
Steering Cover (see Steering Removal in the Steering chapter)

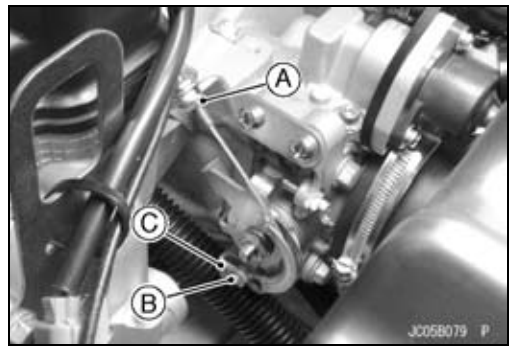
● Remove:
Grommet Mounting Plate Bolts [A]
Grommet Mounting Plate [B]
● Pull up the grommet, and take the throttle cable off the grommet.
● Pull down the throttle cable.




● Remove the band [A] on the delivery pipe assy [B].



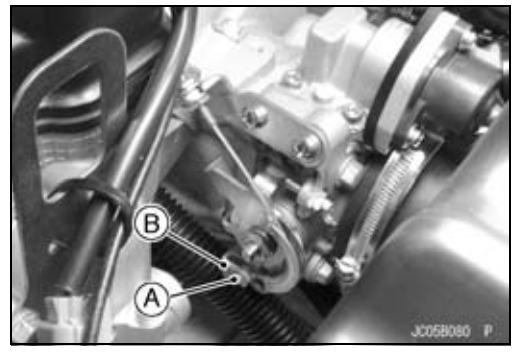

● Disconnect the throttle cable from the throttle body assy.
○Slide out the rubber cap.
○Unscrew the adjuster locknut [A] and slide the cable from the bracket.
○Slide the tip [B] of the cable lower end from the throttle pivot arm [C].



## Throttle Lever, Cable and Case

### *Throttle Cable Installation*

- Apply water-resistance grease to the throttle cable ends.
- Install the throttle cable in accordance with the Cable, Wire, and Hose Routing section in the Appendix chapter.
- Install the throttle cable lower end (see Throttle Body Assy Installation).
- Slide the tip [A] of the cable lower end on the throttle pivot arm [B].
- Install the removed parts (see appropriate chapters).
- After installation, adjust the cable properly (see Throttle Control System Inspection in the Periodic Maintenance chapter).

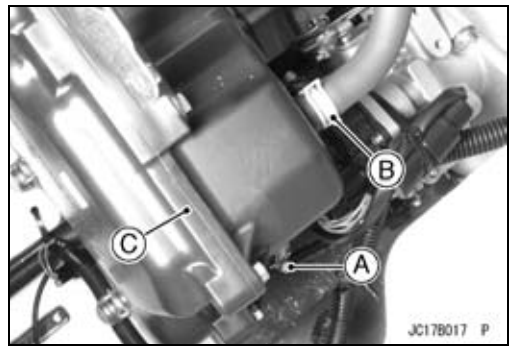



### *Throttle Cable Lubrication*

- Refer to the Lubrication in the Periodic Maintenance chapter.

## Air Box

### *Air Box Removal*



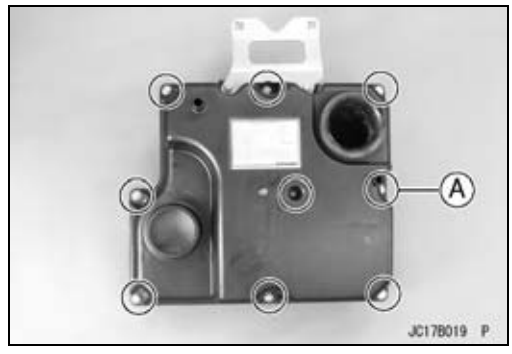

- Remove:
  Handrail Plate (see Handrail Plate Removal in the Hull/Engine Hood chapter)
  Clamp Screw [A] (Loosen)
  Clamp [B]
  Air Box [C]

### *Air Box Installation*

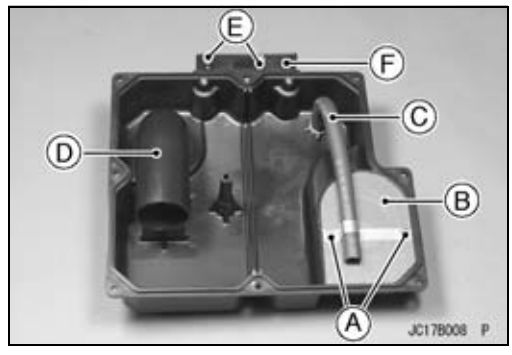
- Installation is the reverse of removal.
- Apply a non-permanent locking agent to the air box bracket mounting bolts and tighten them.

**Torque - Air Box Bracket Mounting Bolts: 8.8 N·m (0.90 kgf·m, 78 in·lb)**

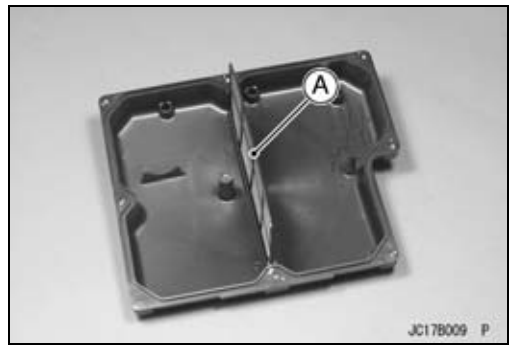
### *Air Box Disassembly*




- Remove:
  Air Box (see Air Box Removal)
  Air Box Bolts [A]



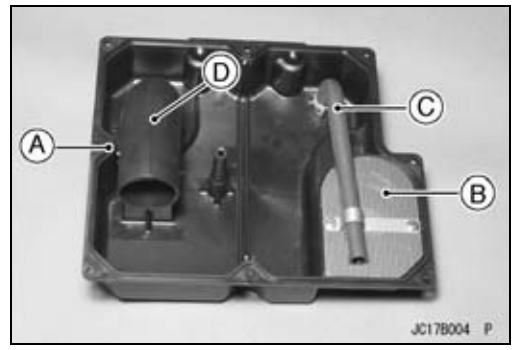

- Remove:
  Bolts [A]
  Flame Arrester [B]
  Hose [C]
  Duct [D]
  Air Box Bracket Mounting Bolts [E]
  Air Box Bracket [F]




- Remove the air screen [A].

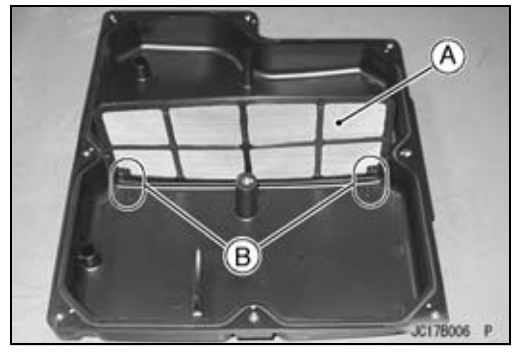
## Air Box

### *Air Box Assembly*




- Visually inspect the seal [A] for damage.
- ★If necessary, replace it with a new one.
- Install the flame arrester [B], hose [C] and duct [D] as shown in the figure.
- Tighten:

**Torque - Air Box Flame Arrester Bolts: 2.5 N·m (0.25 kgf·m, 22 in·lb)**




- Install the air screen [A] aligning the marks [B].
- Install the air box cover.
- Apply a non-permanent locking agent to the air box assembly bolt (L = 60 mm) and mounting bolts.
- Tighten:

**Torque - Air Box Assembly Bolts: 2.5 N·m (0.25 kgf·m, 22 in·lb)**
**Air Box Mounting Bolts: 7.8 N·m (0.80 kgf·m, 69 in·lb)**

## Throttle Body Assy

### *Idle Speed Inspection*

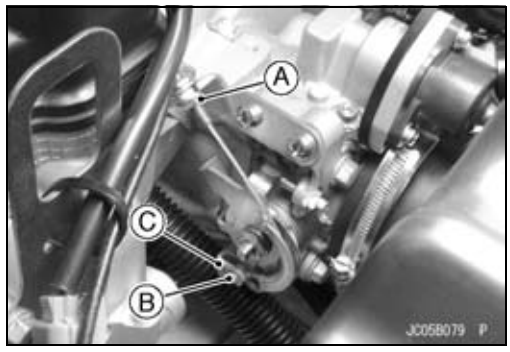
The normal idle speed is controlled by the ECU.

**Idle Speed**

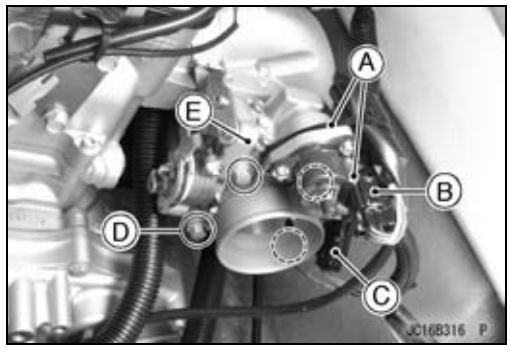
**Standard: 1 300 ±100 r/min (rpm) - both in and out of water**

### *Throttle Body Assy Removal*

- Remove the air box (see Air Box Removal).
- Unscrew the adjuster locknut [A] and slide the cable from the bracket.
- Slide the tip [B] of the cable lower end from the throttle pivot arm [C].




- Remove:
  Bands [A]
  ISC Connector [B]
  Throttle Position Sensor Connector [C]
  Bolts [D]
  Throttle Body Assy [E] with Gasket




### *Throttle Body Assy Installation*

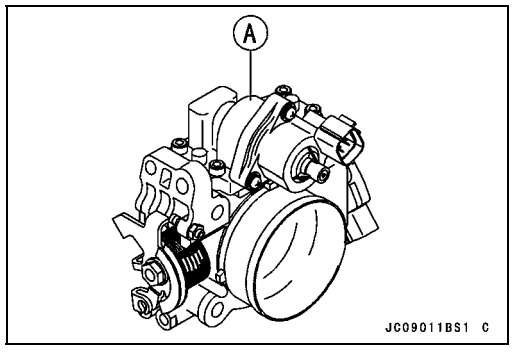
- Replace the gasket with a new one.
- Installation is the reverse of removal.
- Tighten:

**Torque - Throttle Body Assy Mounting Bolts: 20 N·m (2.0 kgf·m, 15 ft·lb)**

### *Throttle Body Assy Disassembly*

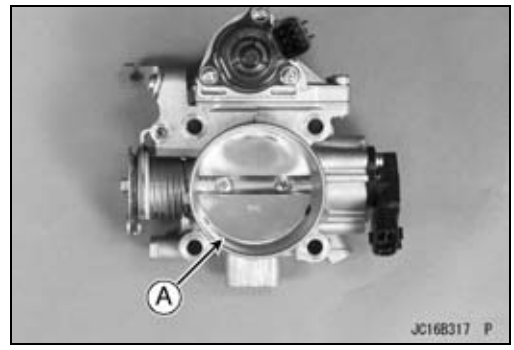
***NOTICE***

**Adjustment of the air screw, throttle link mechanism and throttle body assy [A] could result in poor performance, requiring replacement of the throttle body assy. Do not remove, disassemble or adjust the air screw, throttle link mechanism and throttle body assy, they are precisely set at the manufacturer.**



## Throttle Body Assy

### *Throttle Bore Cleaning*



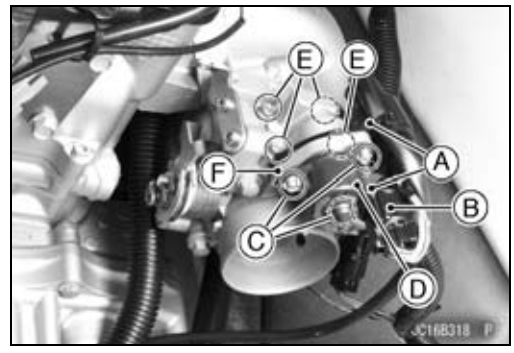

- Remove the throttle body assy (see Throttle Body Assy Removal).
- Check the throttle bore [A] for carbon deposits by opening the valve.

★If any carbon accumulates, wipe the carbon off the throttle bore and throttle valve, using a cotton pad.

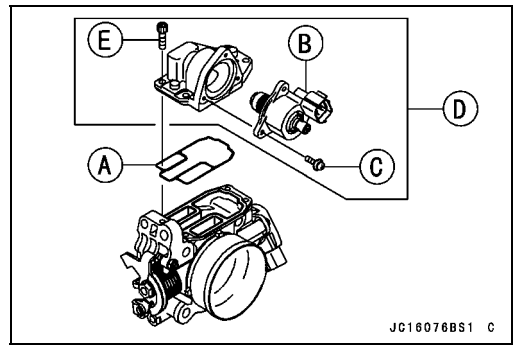
**NOTICE**

**Do not rub these surfaces hard and do not use a carburetor cleaning solution.**

### *ISC (Idle Speed Controller) Removal/Installation*




- Remove:
  Seats (see Seat Removal in the Hull/Engine Hood chapter)
  Air Box (see Air Box Removal)
  Bands [A]
  ISC Connector [B]
  Stepping Motor Mounting Screws [C]
  Stepping Motor [D]
  ISC Actuator Mounting Bolts [E]
  ISC Actuator [F]




- Clean the mating surface of throttle body and ISC actuator (stepping motor).
- Replace the O-ring [A] with a new one.
- Install the stepping motor [B] and tighten the screws [C].

**Torque - Stepping Motor Mounting Screws: 2.0 N·m (0.20 kgf·m, 18 in·lb)**

- Install the ISC actuator [D] and tighten the bolts [E].

**Torque - ISC Actuator Mounting Bolts: 5.0 N·m (0.51 kgf·m, 44 in·lb)**

- Run the harness and tighten the bands correctly (see Cable, Wire and Hose Routing section in the Appendix chapter).
- After installing the ISC actuator, check the Smart Steering System Operation in the water.

### *ISC (Idle Speed Controller) Inspection*

- Check idle speed with a tachometer in the multifunction meter.

○With the engine idling, open and close the throttle lever.

**Idle Speed**
**Standard: 1 300 ±100 r/min (rpm) - both in and out of water**

★If the idle speed is within the standard, the ISC operates properly.

★If the idle speed is out of the specified range, inspect the audible operation.

## Throttle Body Assy

- Run the engine and then stop the engine.
- Certain buzzing and humming sounds will be emitted from the ISC [A] after the engine stop.

★If the ISC sounds, inspect the ISC resistance.
★If the ISC does not sound, replace the steeping motor.

### *ISC Resistance Inspection*

- Remove:
  Air Box (see Air Box Removal)
  ISC Connector [A] (Disconnect)

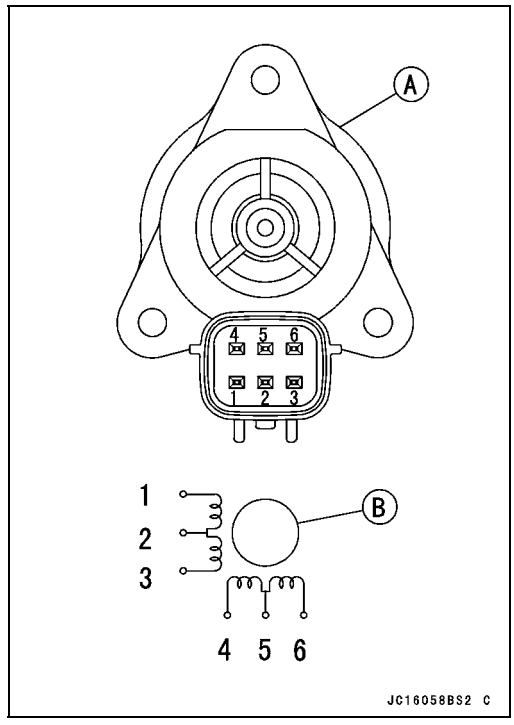
- Measure the ISC resistance with the hand tester.

**Special Tool - Hand Tester: 57001-1394**

ISC [A]
Rotor [B]

**ISC Resistance**
**Connection: 1-2, 2-3, 4-5, 5-6 terminals**
**Standard: About 30 Ω at 20°C (68°F)**
**Connection: 1-3, 4-6 terminals**
**Standard: About 60 Ω at 20°C (68°F)**

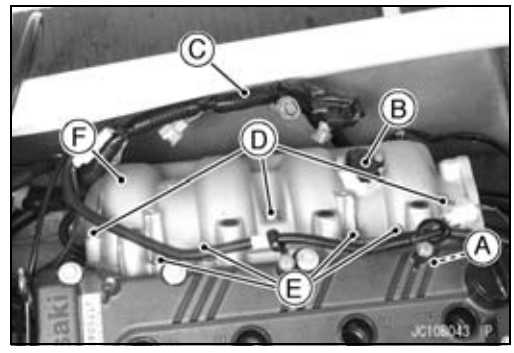
★If the reading is out of the specified value, replace the steeping motor.



## Intake Manifold

### *Intake Manifold Removal*

- Remove:
  Throttle Body Assy (see Throttle Body Assy Removal)
  Fuel Injector with Delivery Pipe Assy (see Fuel Injector Removal)




- Disconnect:
  Intake Air Temperature Sensor Connector [A]
  Intake Air Pressure Sensor Connector [B]
- Free the main harness [C] from the clamps.
- Remove:
  Intake Manifold Mounting Bolts [D] and Nuts [E]
  Intake Manifold [F]

### *Intake Manifold Installation*

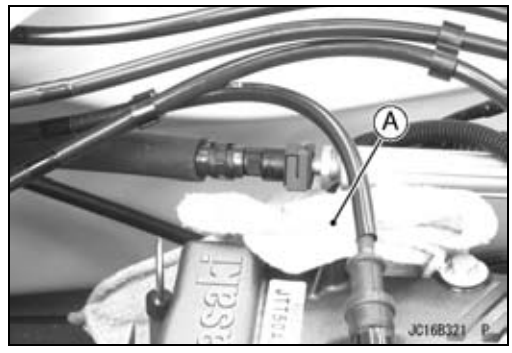
- Replace the intake manifold gasket with a new one.
- Run the hoses, leads and harness correctly (see Cable, Wire, and Hose Routing section in the Appendix chapter).
- Apply a non-permanent locking agent to the intake manifold mounting bolts and tighten them.

**Torque - Intake Manifold Mounting Bolts: 25 N·m (2.5 kgf·m, 18 ft·lb)**
**Intake Manifold Mounting Nuts: 20 N·m (2.0 kgf·m, 15 ft·lb)**

- Install the removed parts (see appropriate chapters).

## Fuel Line

### *Fuel Hose Removal*

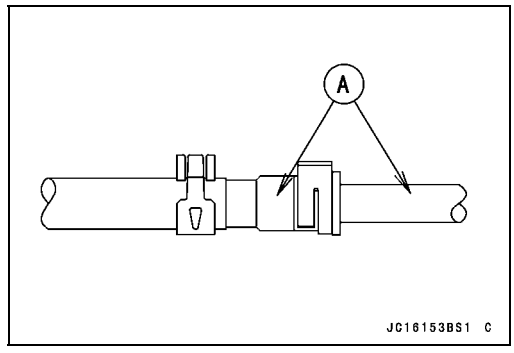



- Remove:
  Seats (see Seat Removal in the Hull/Engine Hood chapter)
- Be sure to place a piece of cloth [A] around the fuel hose joint.

**⚠ WARNING**

**Fuel is flammable and explosive under certain conditions and can cause severe burns. Be prepared for fuel spillage; any spilled fuel must be completely wiped up immediately. When the fuel hose is disconnected, fuel spills out from the hose and the pipe because of residual pressure. Cover the hose connection with a piece of clean cloth to prevent fuel spillage.**

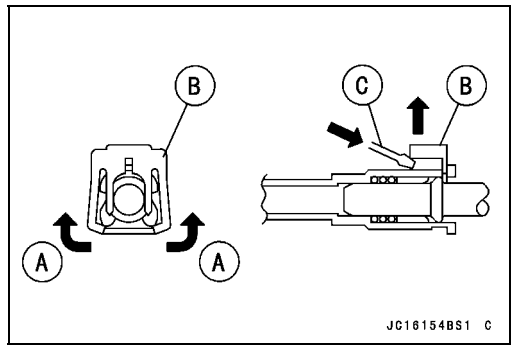
- Wipe off the dirt of the surface [A] around the connection using a cloth or a soft brush.




- Open and push up [A] the joint lock [B] with your fingers or thin blade screwdriver [C].

***NOTICE***

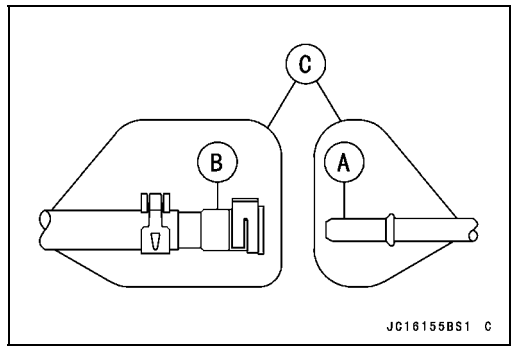
**Prying or excessively widening the joint lock ends for fuel hose removal will permanently deform the joint lock, resulting in a loose or incomplete lock that may allow fuel to leak and create the potential for a fire explosion. To prevent fire or explosion from a damaged joint lock, do not pry or excessively widen the joint lock ends when removing the fuel hose. The joint lock has a retaining edge that locks around the housing.**




- Remove the fuel hose.
- Cover the pipe [A] and the hose joint [B] with the vinyl bags [C] to avoid becoming dirty.

**NOTE**

○*Do not attempt to check the joint lock with fuel hose removed from the pipe. It will not lock into position unless the hose is attached to the pipe.*



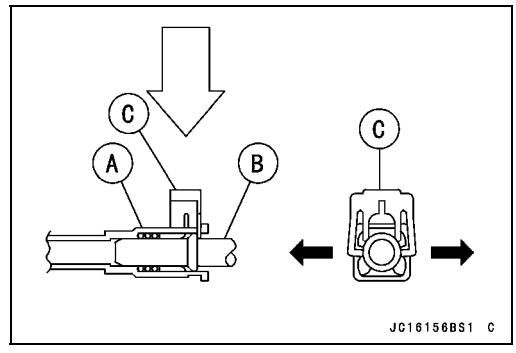
## Fuel Line

### *Fuel Hose Installation*

● Check the joint lock for deformation and wear.

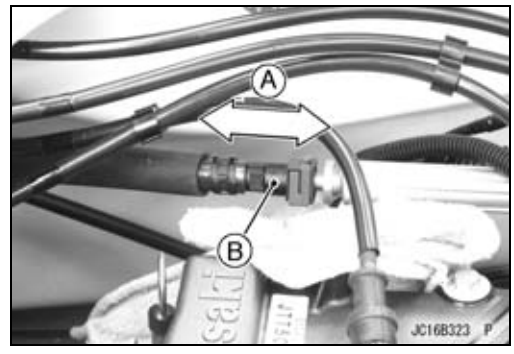
★If the joint lock is deformed [A], replace the fuel hose with a new one.

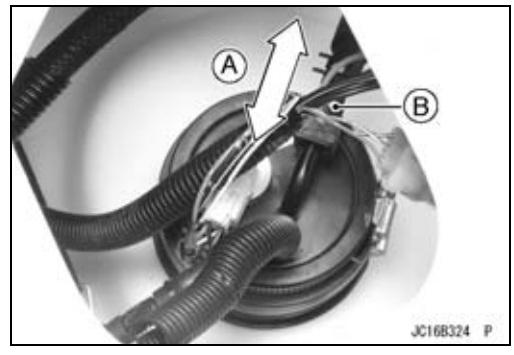
● Insert the hose joint [A] securely onto the pipe [B], and push down the joint lock [C].




● Push and pull [A] the hose joints [B] back and forth more than two times and make sure they are locked and don't come off.

★If it comes off, reinstall the hose joint.



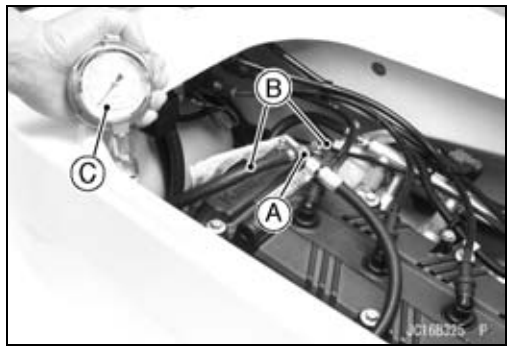

### *Fuel Pressure Inspection*

**NOTE**

○*Be sure the battery is fully charged.*

● Remove the fuel hose (see Fuel Hose Removal).

## Fuel Line




- Install the fuel pressure gauge adapter [A] and fuel hoses (Special Tool: 57001-1607) [B] between the fuel outlet pipe and delivery pipe.
- Secure the fuel hoses with the clamps.
- Connect the pressure gauge [C] to the fuel pressure gauge adapter.

**Special Tools - Oil Pressure Gauge, 5 kgf/cm²: 57001-125**
**Fuel Pressure Gauge Adapter: 57001-1593**
**Fuel Hose: 57001-1607**

**⚠ WARNING**

**Fuel is extremely flammable and can be explosive under certain conditions resulting in serious injury or death.**
**Do not try to start the engine with the fuel hoses disconnected.**

- Insert the ignition key in the ignition switch to turn it on.
- Start the engine, and let it idle.
- Measure the fuel pressure with the engine idling.

**Fuel Pressure (with Engine Idling)**
**Standard: 294 kPa (3.0 kgf/cm², 43 psi)**

**NOTE**

○*The gauge needle will fluctuate. Read the pressure at the average of the maximum and minimum indications.*

- Remove the ignition key.

★If the fuel pressure is much higher than specified, replace the fuel pump because the fuel pressure regulator in the fuel pump have been clogged or stuck.

★If the fuel pressure is much lower than specified, check the following.
Fuel Line Leakage (see Fuel Injector Fuel Line Inspection)
Amount of Fuel Flow (see Fuel Flow Rate Inspection)

- After above checks, measure the fuel pressure again.
- Remove the fuel pressure gauge, hoses and adapter.
- Install the removed parts (see appropriate chapters).
- Start the engine and check for fuel leakage.

### *Fuel Flow Rate Inspection*

**NOTE**

○*Be sure the battery is fully charged.*

**⚠ WARNING**

**Gasoline is extremely flammable and can be explosive under certain conditions, creating the potential for serious burns. Make sure the area is well ventilated and free from any source of flame or sparks; this includes any appliance with a pilot light. Do not smoke. Remove the ignition key. Be prepared for fuel spillage; any spilled fuel must be completely wiped up immediately.**

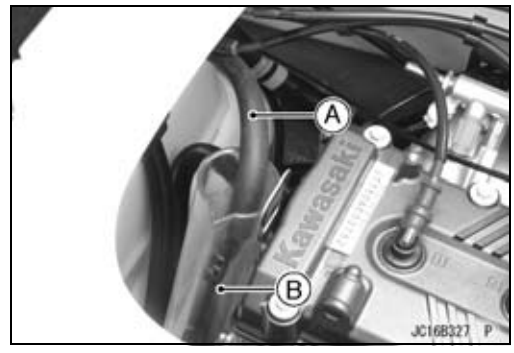
## Fuel Line

- Remove the ignition key.
- Wait until the engine cools down.
- Prepare a measuring cylinder.
- Open the fuel tank cap [A] to lower the pressure in the tank.

- Remove the fuel hose from the delivery pipe (see Fuel Hose Removal).
- Insert the fuel hose [A] into the measuring cylinder [B].

**⚠ WARNING**

**Wipe off spilled out fuel immediately.**
**Be sure to hold the measuring cylinder vertical.**




- Close the fuel tank cap.
- Insert the ignition key in the ignition switch to turn it on.
- Push the start button for 3 seconds.
- Measure the discharge for 3 seconds.

**Amount of Fuel Flow**
**Standard: 83 mL (2.8 US oz.) or more for 3 seconds**

- Remove the ignition key.

★If the fuel flow is much less than the specified, check the following.
Fuel Pump Operation (see Fuel Pump Operation Inspection)
Fuel Pump Screen (see Fuel Pump Screen Cleaning)

★If above inspection checks out good, replace the fuel pump, and measure the amount of fuel flow again.

- After inspection, connect the fuel hose.
- Start the engine and check for fuel leakage.

## Fuel Vent Check Valve

### *Fuel Vent Check Valve Mounting*

- Refer to the Fuel Vent Check Valve Inspection in the Periodic Maintenance chapter.

### *Fuel Vent Check Valve Inspection*

- Refer to the Fuel Vent Check Valve Inspection in the Periodic Maintenance chapter.

## Fuel Pump

### *Fuel Pump Removal*

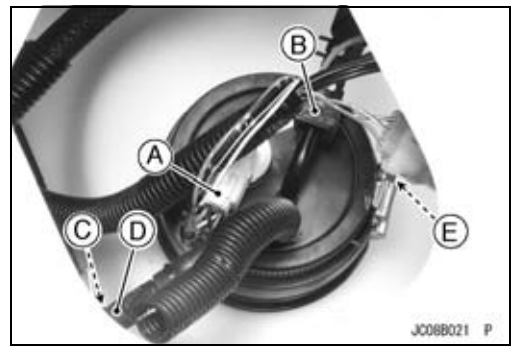
**⚠ WARNING**

**Gasoline is extremely flammable and can be explosive under certain conditions. To avoid a possible fire or explosion, pull the lanyard key off the stop button. Do not smoke. Make sure the area is well ventilated and free from any source of flame or sparks; this includes any appliance with a pilot light.**

***NOTICE***

**A shock to the fuel pump can damage it. Do not drop the fuel pump.**

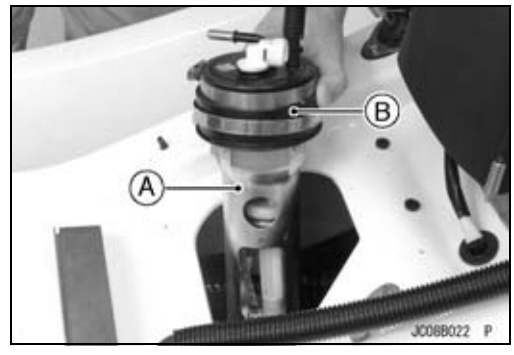
- Remove the center access cover (see Center Access Cover Removal/Installation in the Hull/Engine Hood chapter).
- Disconnect the fuel pump connector [A].
- Pull the fuel hose joint [B] out of the fuel pump pipe (see Fuel Hose Removal).




**⚠ WARNING**

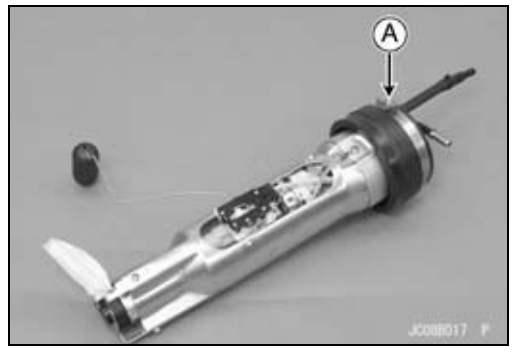
**Fuel is flammable and explosive under certain conditions and can cause severe burns. Be prepared for fuel spillage; any spilled fuel must be completely wiped up immediately. When the fuel hose is disconnected, fuel spills out from the hose and the pipe because of residual pressure. Cover the hose connection with a piece of clean cloth to prevent fuel spillage.**

- Cut the band [C] and pull out the fuel tank vent hose [D].
- Loosen the lower side clamp screw [E] on the fuel pump rubber holder.
- Pull the fuel pump [A] and rubber holder [B] through the opening gained after removal of the access hole on the deck.



## Fuel Pump

- Loosen the upper side clamp screw [A] and remove the rubber holder from the fuel pump.



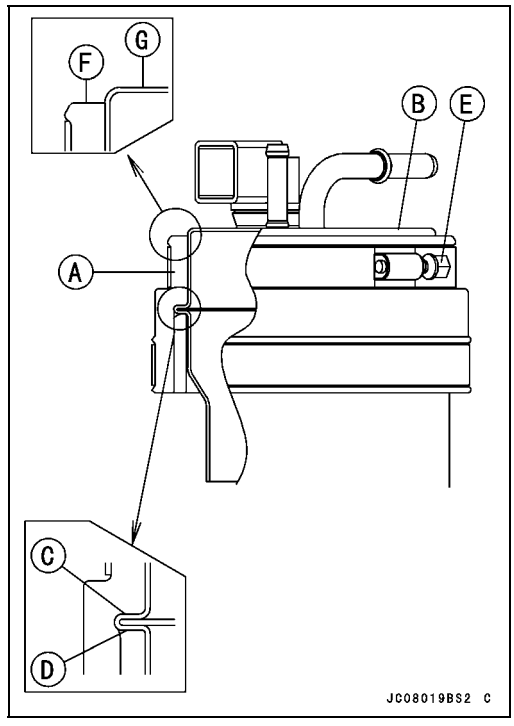

### *Fuel Pump Installation*

- Press down the rubber holder [A] onto the fuel pump [B] so the stepped part [C] of the holder completely contacts the flanged part [D] of the pump.
- Pressing down the rubber holder onto the fuel pump.
- Set the upper side clamp (small diameter) onto the groove (for clamp installation) of the rubber holder securely, tighten the upper side clamp screw [E].

**Torque - Fuel Pump Rubber Holder Clamp Screw: 2.9 N·m (0.30 kgf·m, 26 in·lb)**

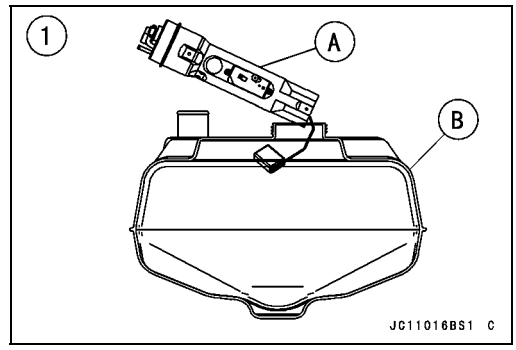
**NOTE**

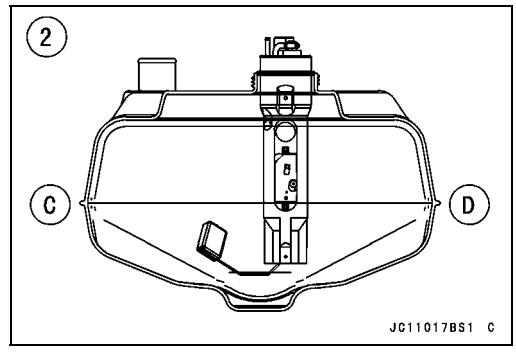
○*Install the rubber holder onto the fuel pump so the rubber holder top surface [F] must be below the top surface [G] of the fuel pump to prevent any water from collecting on top of the pump.*

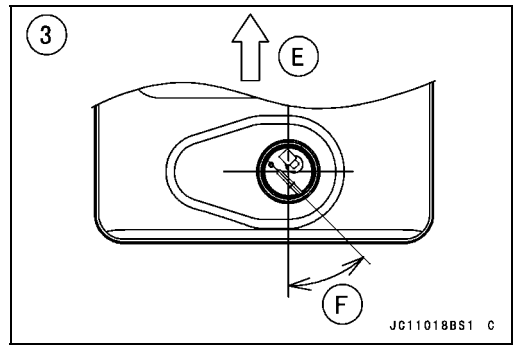


## Fuel Pump

- Insert the fuel pump [A] in the fuel tank [B].
  Port Side [C]
  Starboard Side [D]
  Bow [E]
  45° [F]

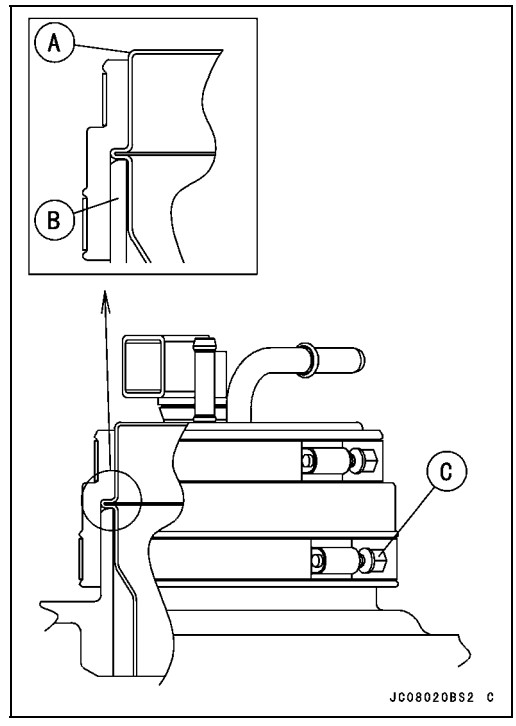


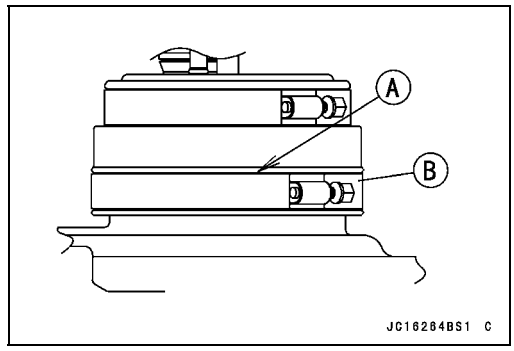

- Press down the pump [A] so that the fuel pump completely contacts the top surface of the tank [B].
- Set the lower side clamp (large diameter) onto the groove (for clamp installation) of the rubber holder securely, tighten the lower side clamp screw [C].

**Torque - Fuel Pump Rubber Holder Clamp Screw: 2.9 N·m (0.30 kgf·m, 26 in·lb)**

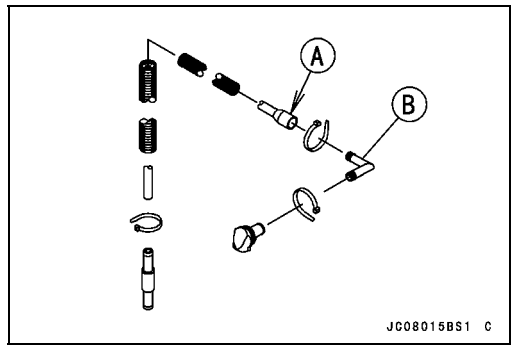


## Fuel Pump

● Check the position [A] of the lower side clamp [B] around the entire circumference.




● Install the following to the fuel pump.
Fuel Hose (see Fuel Hose Installation)
Fuel Tank Vent Hose
Fuel Pump Connector
○Install the vent hose so that the large side [A] of the hose fits the joint [B].




### *Fuel Pump Operation Inspection*

**NOTE**

○*Be sure the battery is fully charged.*

● Insert the ignition key in the ignition switch to turn it on and make sure that the fuel pump operates (make light sounds) for 3 seconds, and then stops.
● Remove the ignition key.
★If the pump does not operate as described above, check the operating voltage (see Fuel Pump Operating Voltage Inspection).

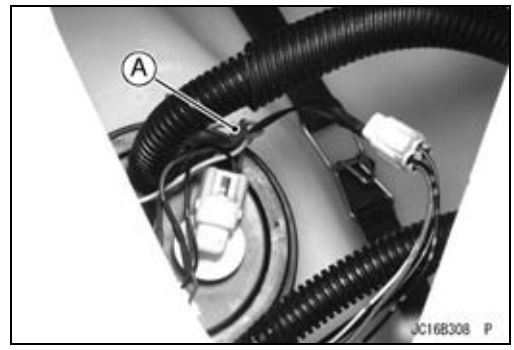
## Fuel Pump

### *Fuel Pump Operating Voltage Inspection*

**NOTE**

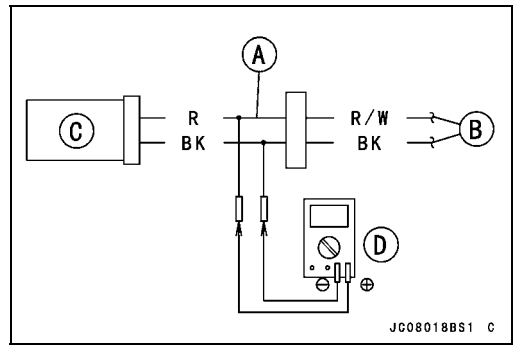
○*Be sure the battery is fully charged.*

- Remove the ignition key.
- Remove the center access cover (see Center Access Cover Removal/Installation in the Hull/Engine Hood chapter).
- Disconnect the fuel pump connector and connect the measuring adapter [A] between these connectors as shown in the figure.
  Main Harness [B]
  Fuel Pump [C]




**Special Tool - Measuring Adapter: 57001-1700**

- Connect a digital meter [D] to the measuring adapter leads.




**Fuel Pump Operating Voltage**
**Connections to Adapter:**
**Digital Meter (+) → R (pump R/W) lead**
**Digital Meter (–) → BK (pump BK) lead**

- Measure the operating voltage with the engine stopped and with the connector joined.
- Insert the ignition key in the ignition switch to turn it on.

**Operating Voltage**
**Standard: Battery Voltage for 3 seconds, and then 0 V**

- Remove the ignition key.

★If the reading stays on battery voltage and never shows 0 V, check the fuel pump relay (see Relay Assembly Inspection in the Electrical System chapter).

★If the fuel pump relay is normal, check the ECU for its ground and power supply (see ECU Power Supply Inspection).

★If the ground and power supply are good, replace the ECU (see ECU Removal/Installation).

★If there is still no battery voltage, check the fuel pump relay (see Relay Assembly Inspection in the Electrical System chapter).

★If the fuel pump relay is normal, check the wiring for continuity (see wiring diagram in this section).

**Special Tool - Hand Tester: 57001-1394**

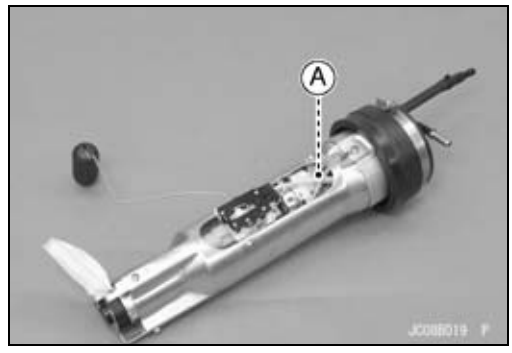
★If the wiring is good, check the ECU for its ground and power supply (see ECU Power Supply Inspection).

★If the ground and power supply are good, replace the ECU (see ECU Removal/Installation).

★If the reading is in specification, but the pump does not operate, replace the fuel pump (see Fuel Pump Removal/Installation).

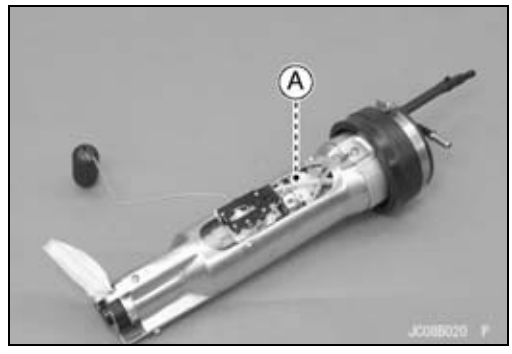
## Fuel Pump

### *Pressure Regulator Removal*




○The pressure regulator [A] is built into the fuel pump and can not be removed.

### *Fuel Filter Cleaning*




○The fuel filter [A] is built into the fuel pump and can not be cleaned or checked.

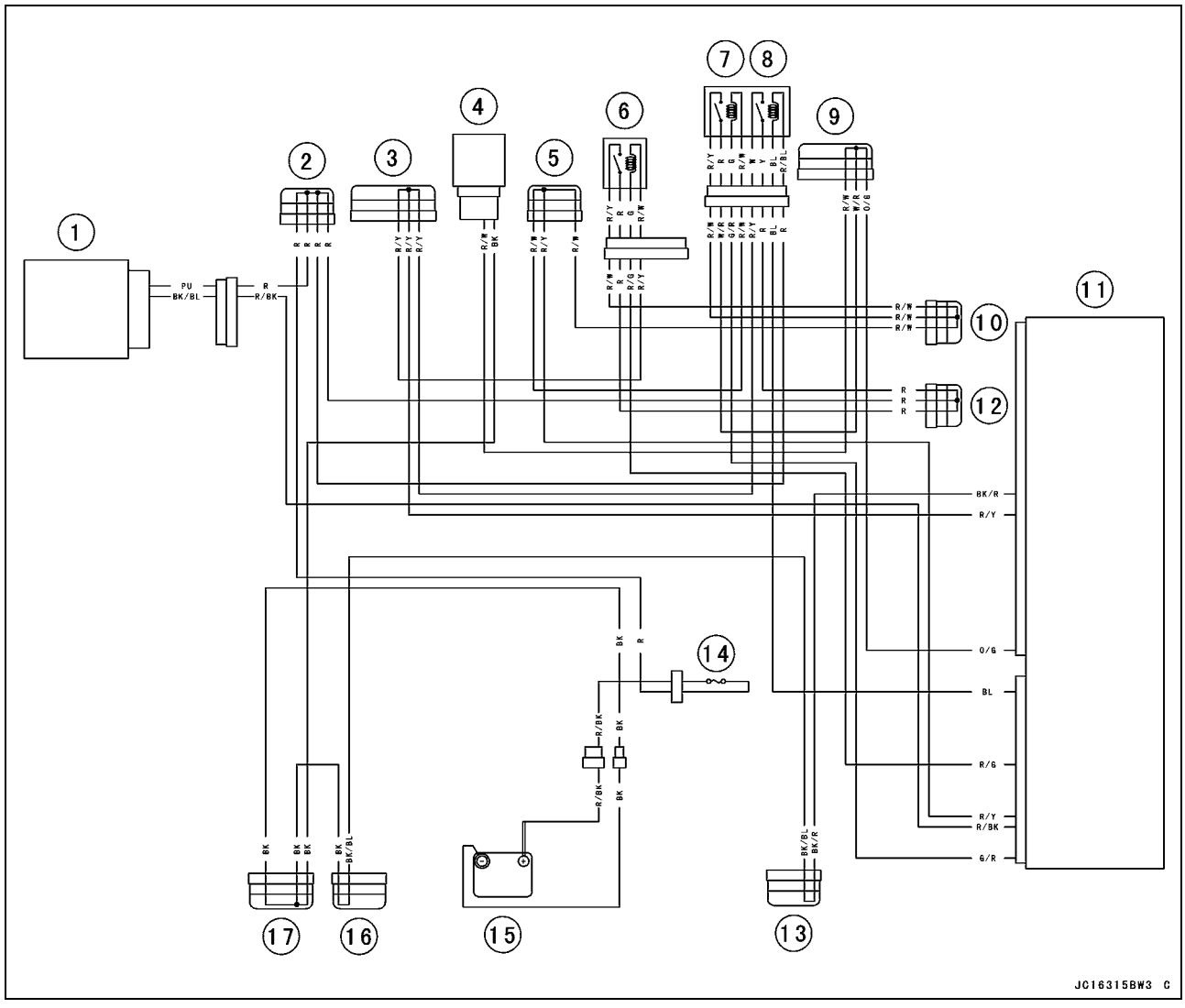
★If the fuel filter is suspected of clogging or being damaged, replace it with the fuel pump as a set.

### *Fuel Pump Screen Cleaning*

● Refer to the Fuel Pump Screen Cleaning in the Periodic Maintenance chapter.

## Fuel Pump

### Fuel Pump Circuit




1. Ignition Switch
2. Joint Connector P (12 V)
3. Joint Connector R (12 V)
4. Fuel Pump
5. Joint Connector T (12 V)
6. ECU Main Relay
7. Fuel Pump Relay
8. System Relay
9. Joint Connector L (12 V)
10. Joint Connector D (12 V)
11. ECU
12. Joint Connector C (12 V)
13. Joint Connector E (Ground)
14. Main Fuse 20 A
15. Battery
16. Joint Connector Y (Ground)
17. Joint Connector S (Ground)

## Fuel Tank

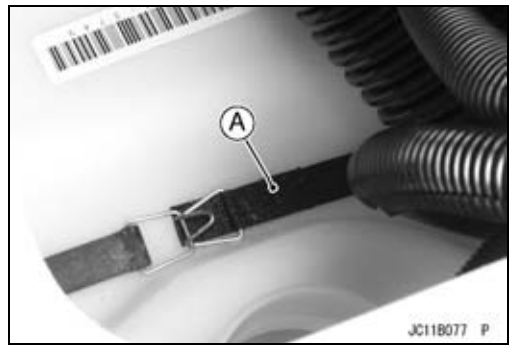
### *Fuel Tank Removal*

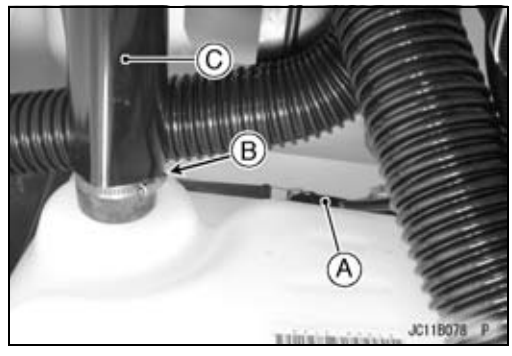
**⚠ WARNING**

**Gasoline is extremely flammable and can be explosive under certain conditions. To avoid a possible fire or explosion, pull the lanyard key off the stop button. Do not smoke. Make sure the area is well ventilated and free from any source of flame or sparks; this includes any appliance with a pilot light.**

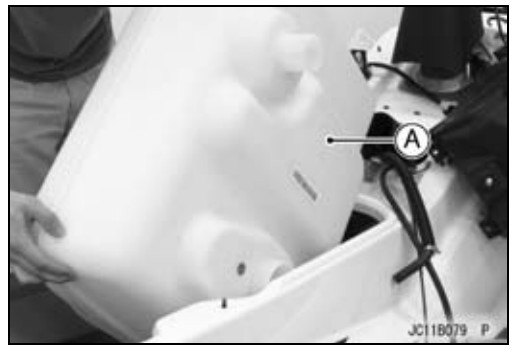
- Draw the fuel out from the fuel tank with a commercially available pump.
- Remove:
  Engine (see Engine Removal in the Engine Removal/Installation)
  Fuel Pump (see Fuel Pump Removal)
  Bracket (for Vehicle-down Sensor, Ignition Coils and Regulator/Rectifier) (see Vehicle-down Sensor Removal)

- Unhook the fuel tank straps [A].
- Loosen the clamp screw [B], and remove the hose [C].



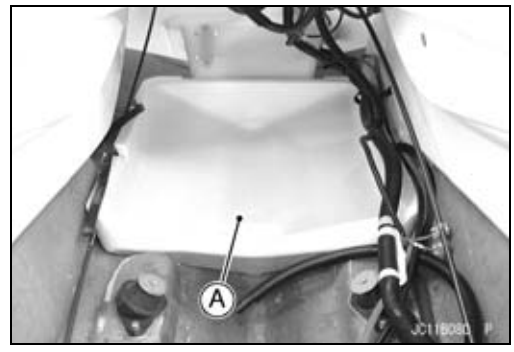




- Remove the fuel tank [A] out of the hull as shown in the figure.



## Fuel Tank

### *Fuel Tank Installation*




- Installation is the reverse of removal, note the following.

○Be sure the float [A] in place before putting the fuel tank into the hull.

### *Fuel Tank Cleaning*

**⚠ WARNING**

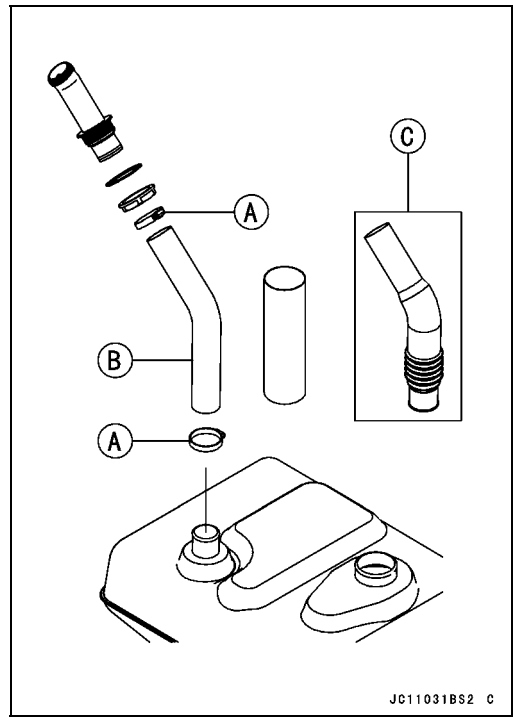
**Gasoline and low flash-point solvents can be flammable and/or explosive and cause severe burns. Clean the tank in a well-ventilated area, and take care that there are no sparks or flame anywhere near the working area; this includes any appliance with a pilot light. Do not use gasoline or a low flash-point solvent to clean the tank.**

- Remove the fuel tank (see Fuel Tank Removal).
- Flush the tank repeatedly with high flash-point solvent until it is clean. It may be necessary to put a few marbles or pieces of clean gravel into the tank and shake it, to knock loose any foreign matter in the bottom.

### *Fuel Filler and Hose Removal*

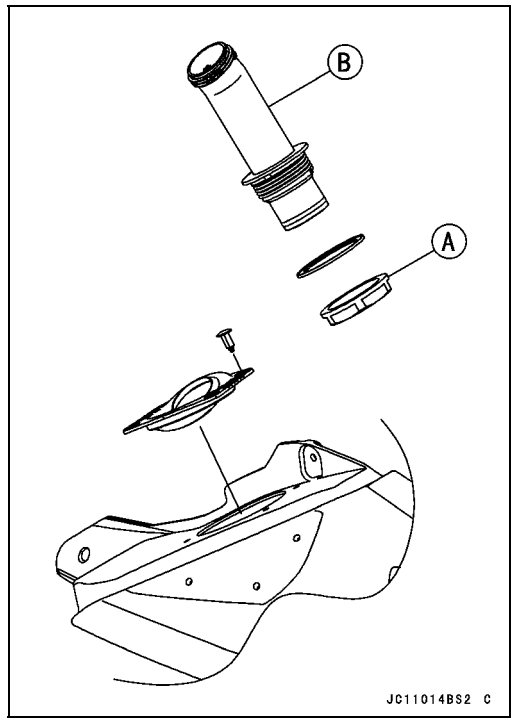
- Remove the front access cover (see Front Access Cover Removal/Installation in the Hull/Engine Hood chapter).
- Loosen the fuel filler hose clamp screws [A] and remove the fuel filler hose [B].

AU and EUR Models [C]



## Fuel Tank

- Remove the left side cover (see Side Cover Removal in the Hull/Engine Hood chapter).
- Take out the nut [A] in the filler flange and remove the fuel filler [B].




### *Fuel Filler and Hose Installation*

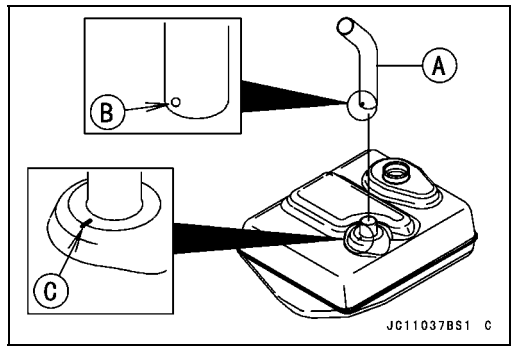
- Clean the deck and filler on their mating surfaces with greaseless, high flash-point solvent.

**⚠ WARNING**

**Gasoline and low flash-point solvents can be flammable and/or explosive and cause severe burns. Clean the parts in a well-ventilated area, and take care that there is no spark or flame anywhere near the working areas. Do not use gasoline or low flash-point solvents to clean parts.**

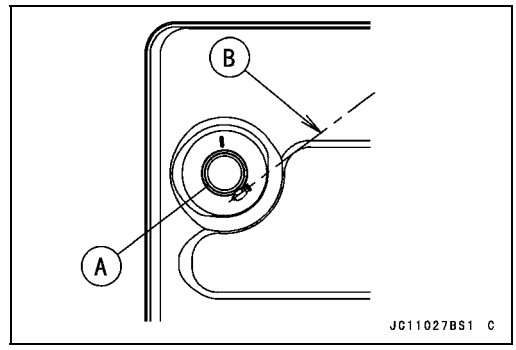
- Note the following when installing the hose [A].

○Fit the white mark [B] of the hose to the mark [C] of the tank.



## Fuel Tank

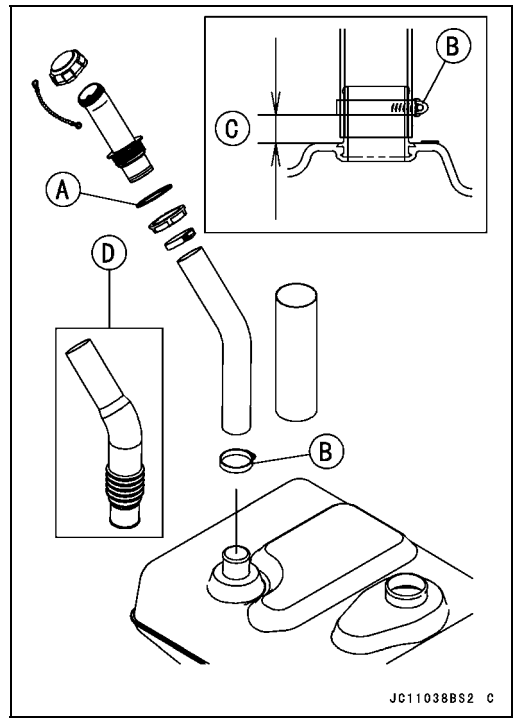
○Install the lower clamp [A] so that its screw head screw points inclined line [B].




- Replace the fuel filler gasket [A] with a new one.
- Tighten the lower [B] and upper fuel filler hose clamp screws.

**Torque - Fuel Filler Hose Clamp Screws: 2.9 N·m (0.30 kgf·m, 26 in·lb)**

Parallel with Fuel Tank at 20 ~ 25 mm (0.79 ~ 0.98 in.) height [C]
AU and EUR Models [D]



# Engine Lubrication System

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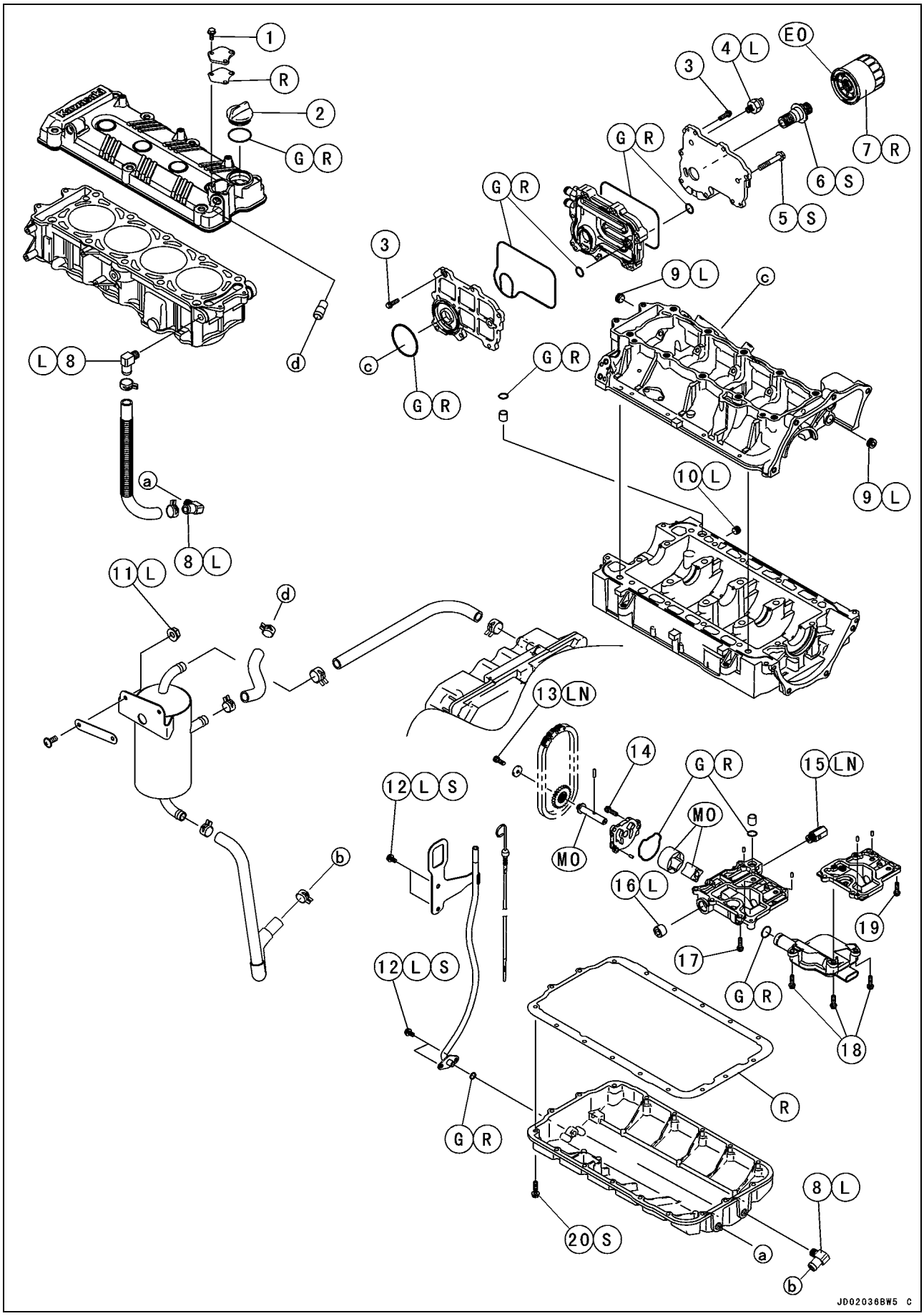
## Exploded View

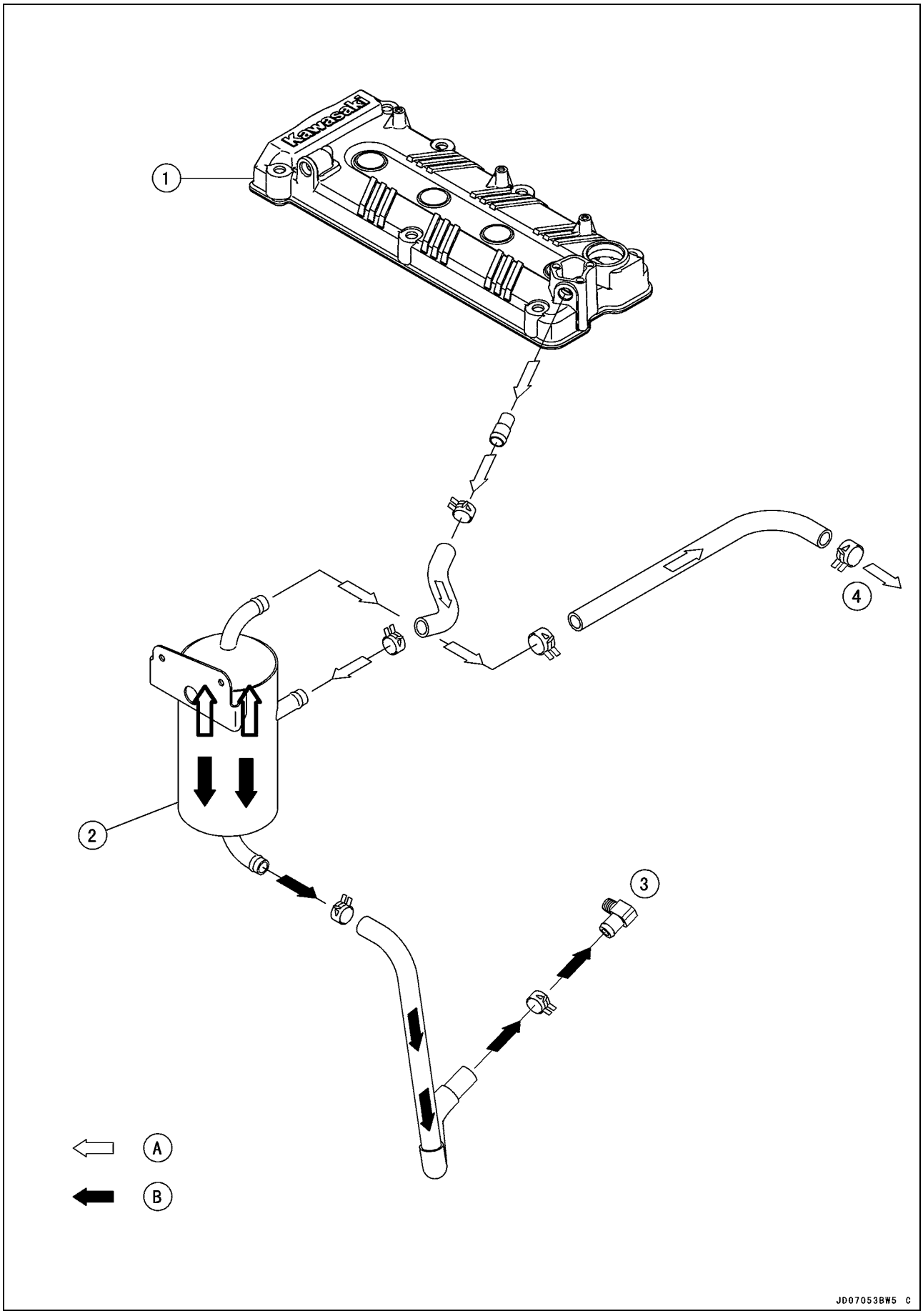


## Exploded View

| No. | Fastener | Torque | | | Remarks |
|---|---|---|---|---|---|
| | | N·m | kgf·m | ft·lb | |
| 1 | Breather Plate Bolts | 7.8 | 0.80 | 69 in·lb | |
| 2 | Oil Filler Cap | – | – | – | Hand-tighten |
| 3 | Oil Cooler Assembly Bolts | 7.8 | 0.80 | 69 in·lb | |
| 4 | Oil Pressure Switch | 15 | 1.5 | 11 | L |
| 5 | Oil Cooler Positioning Bolt | 20 | 2.0 | 15 | S |
| 6 | Oil Passage Bolt | 78 | 8.0 | 58 | S |
| 7 | Oil Filter | 18 | 1.8 | 13 | EO, R |
| 8 | Oil Passage Joints | 11 | 1.1 | 97 in·lb | L |
| 9 | Oil Passage Plugs (R3/8) | 20 | 2.0 | 15 | L |
| 10 | Oil Passage Plug (R1/4) | 7.8 | 0.80 | 69 in·lb | L |
| 11 | Oil Separator Tank Mounting Nuts | 4.9 | 0.50 | 43 in·lb | L |
| 12 | Dipstick Tube Bolts | 8.8 | 0.90 | 78 in·lb | L, S |
| 13 | Oil Pump Sprocket Bolt | 16 | 1.6 | 12 | LN |
| 14 | Oil Pump Cover Bolts | 7.8 | 0.80 | 69 in·lb | |
| 15 | Oil Pressure Relief Valve | 15 | 1.5 | 11 | LN |
| 16 | Oil Pump Body Plug | 20 | 2.0 | 15 | L |
| 17 | Oil Pump Body Bolts | 7.8 | 0.80 | 69 in·lb | |
| 18 | Oil Screen Bolts | 7.8 | 0.80 | 69 in·lb | |
| 19 | Oil Catch Cover Bolts | 7.8 | 0.80 | 69 in·lb | |
| 20 | Oil Pan Bolts | 20 | 2.0 | 15 | S |

EO: Apply engine oil.
G: Apply grease.
L: Apply a non-permanent locking agent.
LN: Apply a non-permanent locking agent (High Strength: Loctite 271 equivalent).
MO: Apply molybdenum disulfide oil solution.
(mixture of the engine oil and molybdenum disulfide grease in a weight ratio 10:1)
R: Replacement Parts
S: Follow the specified tightening sequence.

## Engine Oil Flow Chart

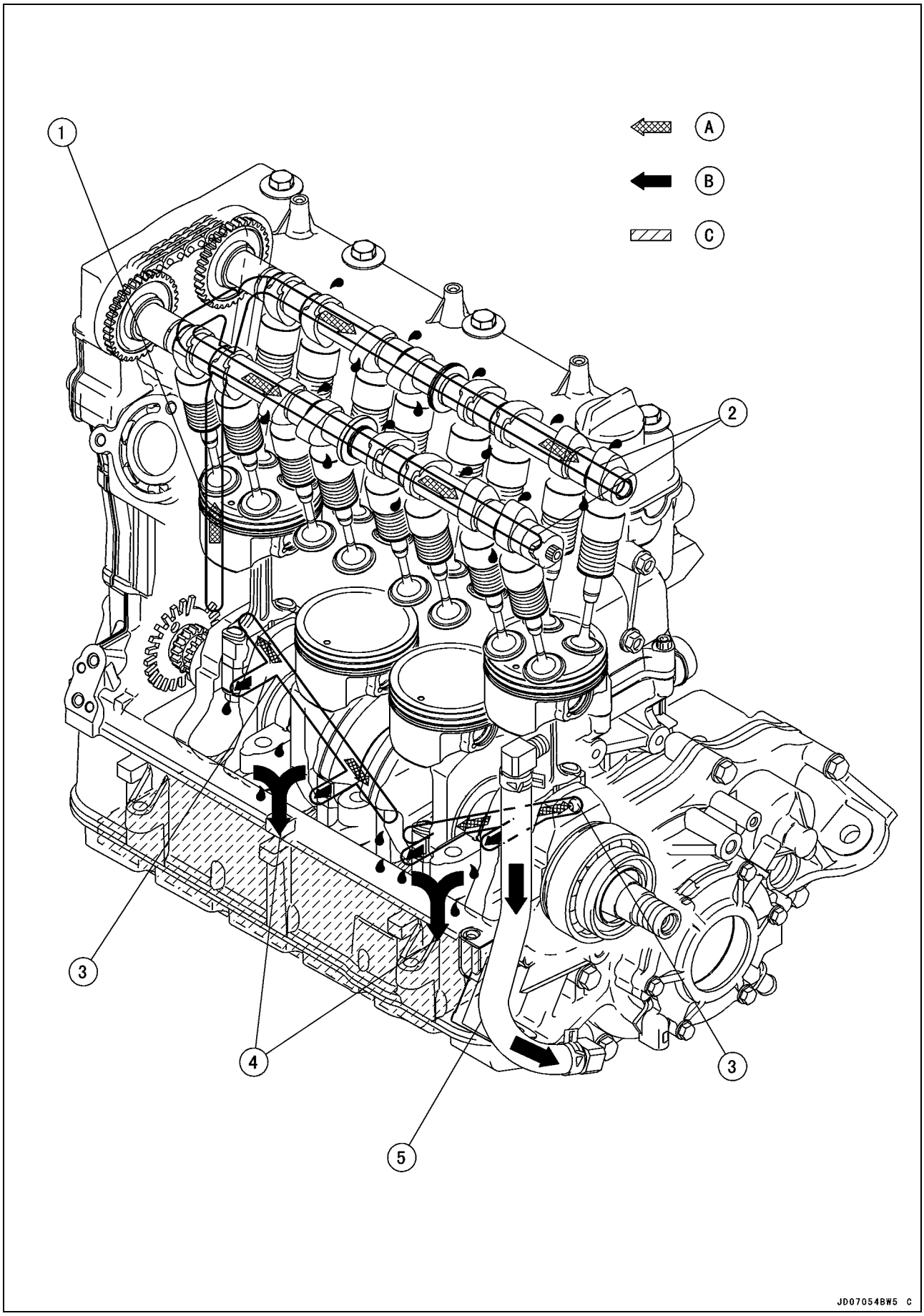


## Engine Oil Flow Chart

1. Cylinder Head Cover
2. Oil Separator Tank
3. To Oil Pan
4. To Air Box

A. Blowby Gas
B. Return Engine Oil Flow

## Engine Oil Flow Chart

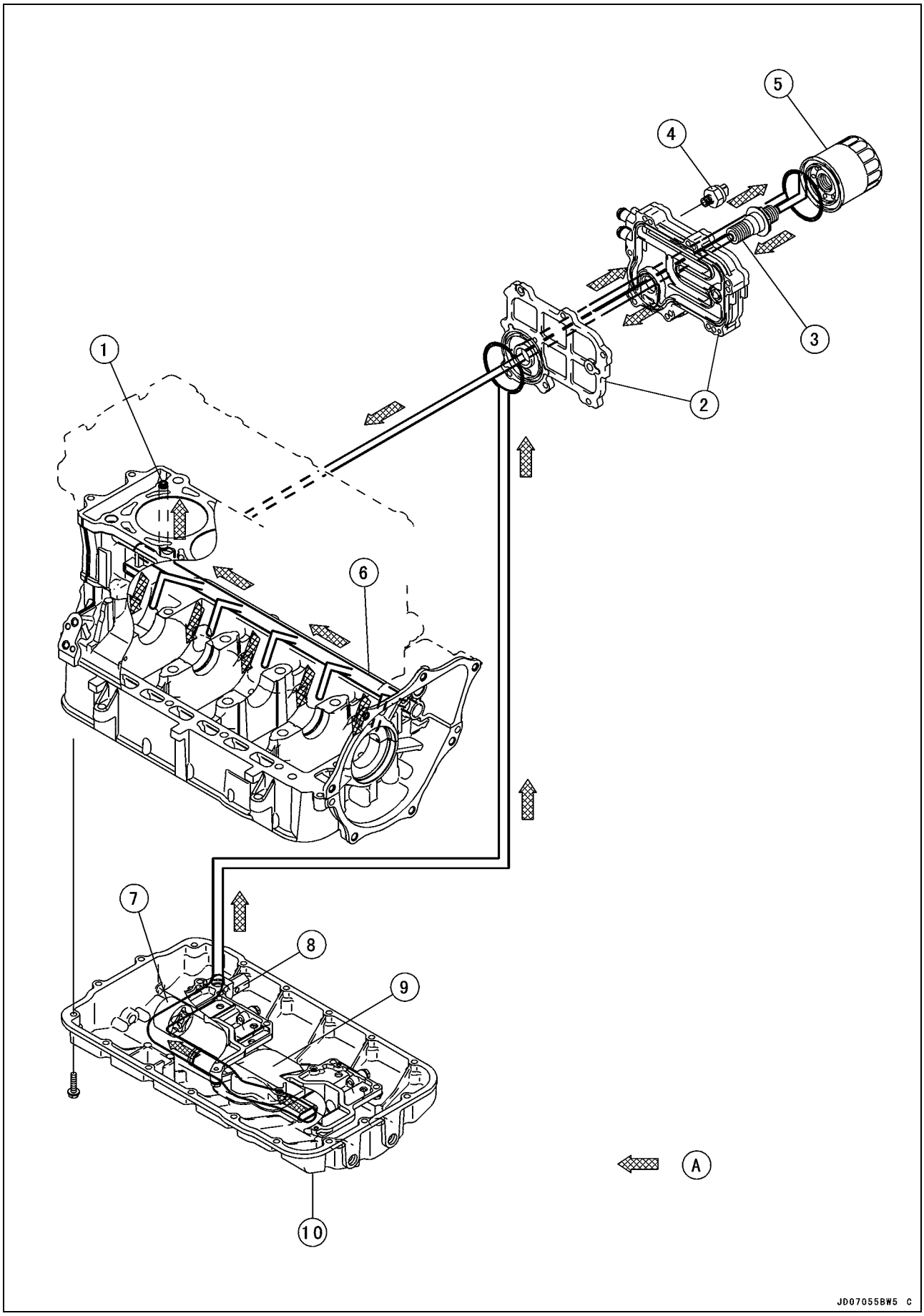


## Engine Oil Flow Chart

1. Oil Passage (From Oil Pipe to Camshaft Cap)
2. Camshaft Oil Passage
3. Crankshaft Oil Passage
4. To Oil Pan
5. Oil Hose (From Cylinder to Oil Pan)

A. Supply Engine Oil Flow
B. Return Engine Oil Flow
C. Oil Sump

## Engine Oil Flow Chart



## Engine Oil Flow Chart

1. Oil Pipe
2. Oil Cooler
3. Oil Passage Bolt
4. Oil Pressure Switch
5. Oil Filter
6. Main Oil Passage
7. Oil Pump
8. Relief Valve
9. Oil Screen
10. Oil Pan

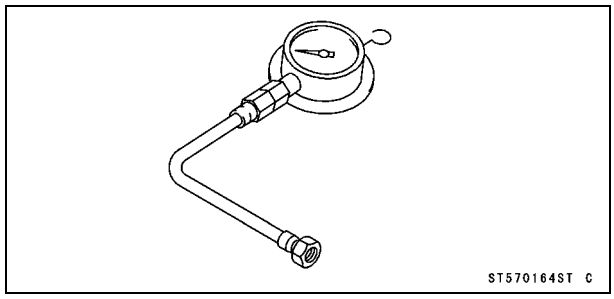
A. Supply Engine Oil Flow

## Specifications

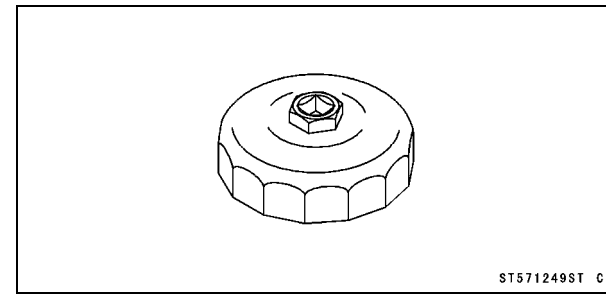
| Item | Standard |
|---|---|
| **Engine Oil** | |
| Grade | API SG, SH, SJ, SL or SM with JASO MA, MA1 or MA2 |
| Viscosity | SAE 10W-40 |
| Capacity | 4.0 L (4.2 US qt, when filter is not removed)<br>4.2 L (4.4 US qt, when filter is removed)<br>5.0 L (5.3 US qt, when engine is completely dry) |
| Level | Between upper and lower level lines (see text) |
| **Oil Pressure Measurement** | |
| Oil Pressure | 461 kPa (4.7 kgf/cm², 67 psi) at 3 000 r/min (rpm), Oil Temperature 74°C (165°F) |

## Special Tools

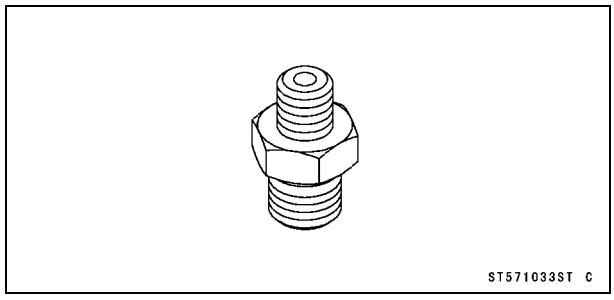
**Oil Pressure Gauge, 10 kgf/cm²:**
**57001-164**




**Oil Filter Wrench:**
**57001-1249**




**Oil Pressure Gauge Adapter, PT 1/8:**
**57001-1033**



## Engine Oil and Oil Filter

**⚠ WARNING**

**Insufficient, deteriorated or contaminated engine oil causes accelerated engine wear and may result in sudden catastrophic engine failure that can lead to an accident resulting in serious injury or death. Change the engine oil according to the periodic maintenance chart and check the oil level regularly between oil changes.**

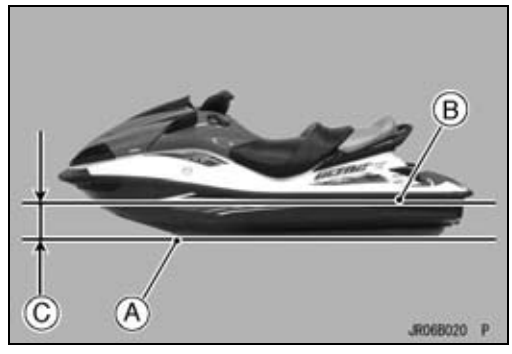
### *Oil Level Inspection*

This watercraft engine is equipped with a semi-dry sump. In the semi-dry sump engine, the oil level difference is very large between the level measured after just stopping and that after leaving for a long time.

It is necessary to check the specified amount of oil is in the engine before starting the engine every day. At this time use the cold mark of the level gauge. Then run the engine to lubricate the engine parts sufficiently. After that it is necessary to check the level by using hot mark of the level gauge.

**Preliminary Check**

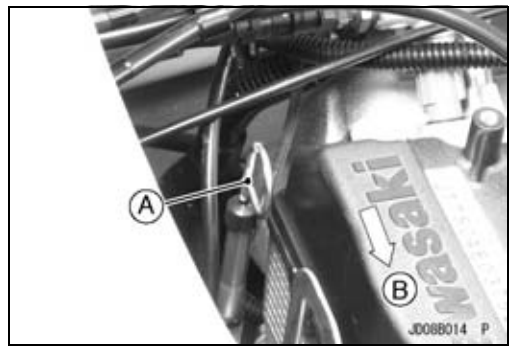
- Remove the seats (see Seat Removal in the Hull/Engine Hood chapter).
- Whenever checking the engine oil level, keep the watercraft level side to side and fore to aft as much as possible.
  Level Ground [A]
  Side Bumper [B]
  Parallel [C]



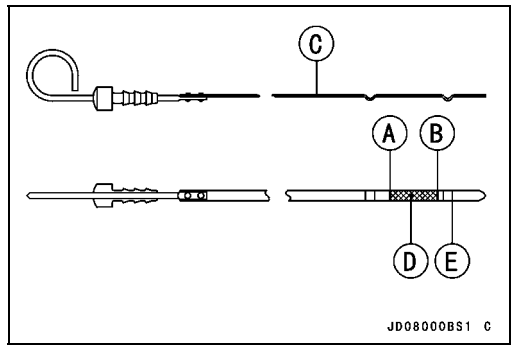

- Remove the dipstick [A], wipe it dry and insert it back into the dipstick so that the finger grip is positioned toward the left side [B] of the hull.
- Remove it again to check the oil level.

**NOTE**

○*An accurate oil level cannot be obtained if the dipstick is not installed in the correct direction.*




- The oil level must be between the High and Low level lines on the dipstick (Use level lines when engine is cold).
  High Level Line when Cold [A]
  Low Level Line when Cold [B]
  Dipstick [C]
  High Level Line when Hot [D]
  Low Level Line when Hot [E]



## Engine Oil and Oil Filter

***NOTICE***

**Racing the engine before the oil reaches every part can cause engine seizure.**
**If the engine oil gets extremely low or if the oil pump or oil passages clog up or otherwise do not function properly, the oil pressure warning light will light. If this light stays on when the engine is running above idle speed, stop the engine immediately and find the cause.**

★If the oil level is too high, remove the excess oil using a syringe or some other suitable device.
★If the oil level is too low, add the oil to the low level line through the oil filler opening (see Engine Oil Change in the Periodic Maintenance chapter). Use the same type and make of oil that is already in the engine.

**NOTE**

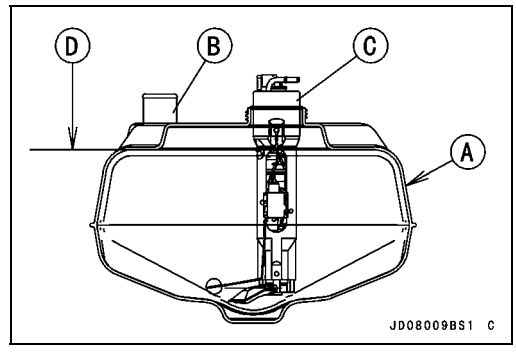
○*If the engine oil type and make are unknown, use any brand of the specified oil to top off the level in preference to running the engine with the oil level low. Then at your earliest convenience, change the oil completely.*

**Ordinary (standard) Check**

- Perform the preliminary check before the ordinary check.
- Install the removed parts.
- Launch the watercraft.
- Start the engine for several minutes.
- Ride the watercraft and run the engine at about 5 000 rpm for 5 minutes.
- Stop the engine and let it cool down for 10 minutes.
- Steady the watercraft in calm water to prevent movement, or on the ground, keep the watercraft level side to side and fore to aft as much as possible.

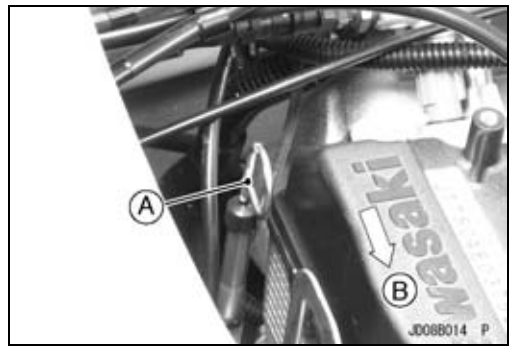
**NOTE**

○*Since the trim and list of the watercraft will significantly affect the oil level, be sure that the operator and/or cargo are not aboard the watercraft when measuring the oil level.*
○*Also make the fuel tank [A] full if it is not full as shown to keep the watercraft level.*
*Fuel Tank Filler Neck [B]*
*Fuel Pump [C]*
*Fuel Full Level [D]*
○*This measuring procedure with the watercraft afloat should be followed when the oil level is found low and to be added.*



## Engine Oil and Oil Filter

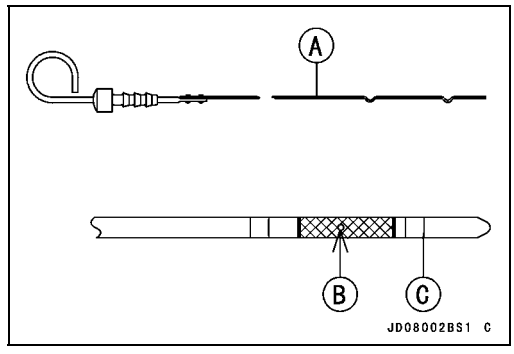
- Remove the seats (see Seat Removal in the Hull/Engine Hood chapter).
- Remove the dipstick [A], wipe it dry and insert it back into the dipstick so that the finger grip is positioned toward the left side [B] of the hull.
- Remove it again to check the oil level.



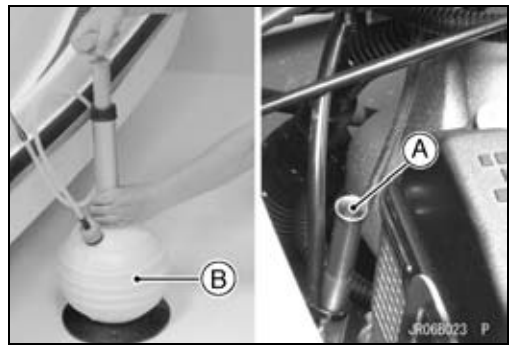

**NOTE**

○*An accurate oil level cannot be obtained if the dipstick is not installed in the correct direction.*

- Check the oil level using the hot level mark on the dipstick [A].
  High Level Line when Hot [B]
  Low Level Line when Hot [C]




★If the oil level is too high, drain the excess oil thoroughly from the dipstick tube [A] using a commercially-available vacuum pump [B].




★If the oil level is too low, add the oil to the high level line through the oil filler opening (see Engine Oil Change in the Periodic Maintenance chapter). Use the same type and make of oil that is already in the engine.

**NOTE**

○*If the engine oil type and make are unknown, use any brand of the specified oil to top off the level in preference to running the engine with the oil level low. Then at your earliest convenience, change the oil completely.*

### *Engine Oil Change*

- Refer to the Engine Oil Change in the Periodic Maintenance chapter.

### *Oil Filter Replacement*

- Refer to the Oil Filter Replacement in the Periodic Maintenance chapter.

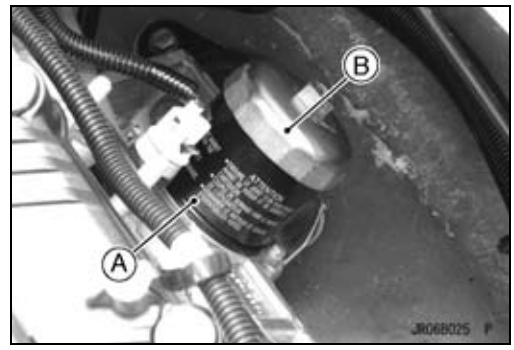
## Oil Cooler

### *Oil Cooler Removal*

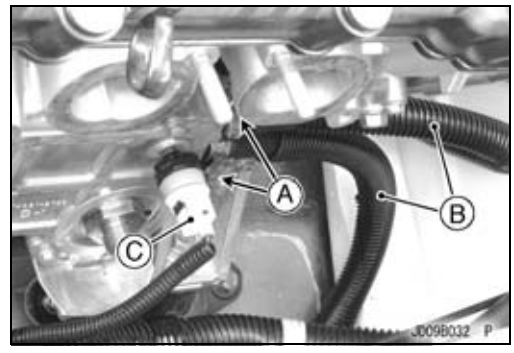
- Remove:
  Intake Manifold (see Intake Manifold Removal in the Fuel System (DFI) chapter)
- Remove the oil filter [A] with the oil filter wrench [B].

○Place a rag or cloth under the oil filter to receive the remaining oil.

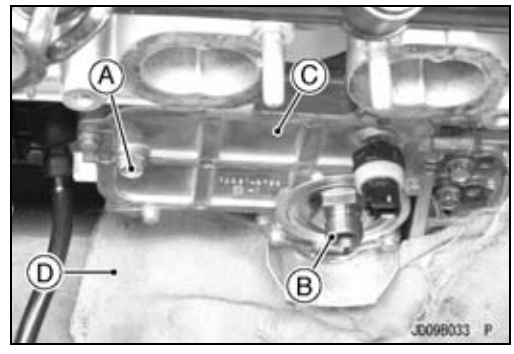
**Special Tool - Oil Filter Wrench: 57001-1249**




- Loosen the clamp screws [A] and remove the oil cooler water hoses [B] from the oil cooler.
- Disconnect the oil pressure switch connector [C].

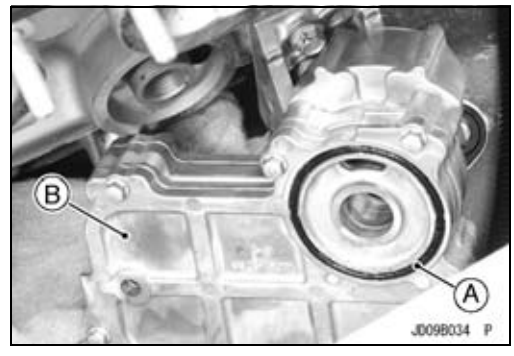



- Remove the oil cooler positioning bolt [A].
- Remove the oil passage bolt [B] and remove the oil cooler [C].
- Place a rag or cloth [D] under the oil cooler to receive the remaining oil.




### *Oil Cooler Installation*

- Replace the O-ring [A] with a new one and apply grease to new O-ring.
- Fit the O-ring on the oil cooler [B] securely.

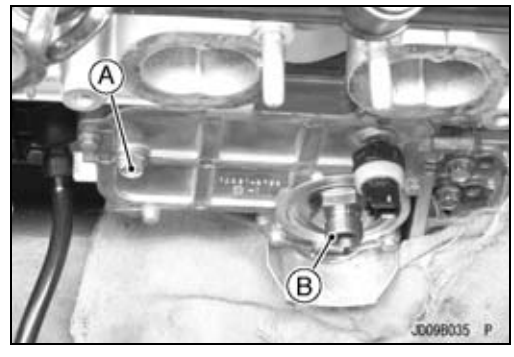



- Install the oil cooler positioning bolt [A] and the oil passage bolt [B] temporarily.

○First, tighten the oil passage bolt.

○Next, tighten the oil cooler positioning bolt.

**Torque - Oil Passage Bolt: 78 N·m (8.0 kgf·m, 58 ft·lb)**
**Oil Cooler Positioning Bolt: 20 N·m (2.0 kgf·m, 15 ft·lb)**



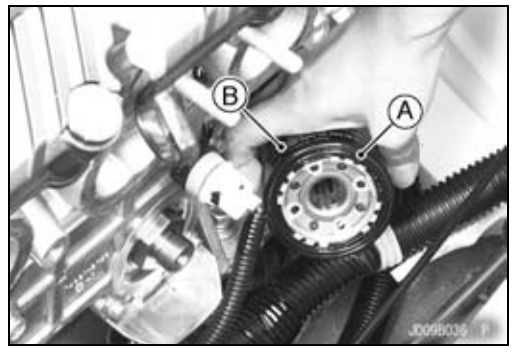
## Oil Cooler

- Install the water hoses (see Cable, Wire and Hose Routing section in the Appendix chapter).
- Replace the oil filter with a new one.
- Apply engine oil to the O-ring [A] of the new oil filter [B].
- Tighten the oil filter with the oil filter wrench.

**Special Tool - Oil Filter Wrench: 57001-1249**

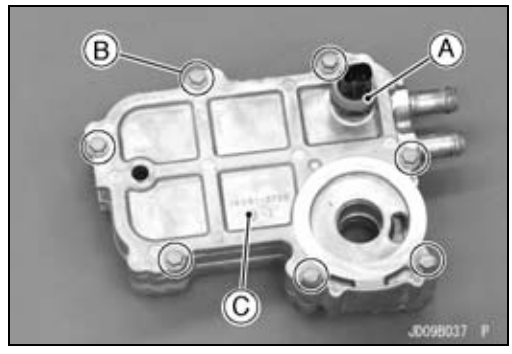
**Torque - Oil Filter: 18 N·m (1.8 kgf·m, 13 ft·lb)**

- Install the removed parts (see appropriate chapters).

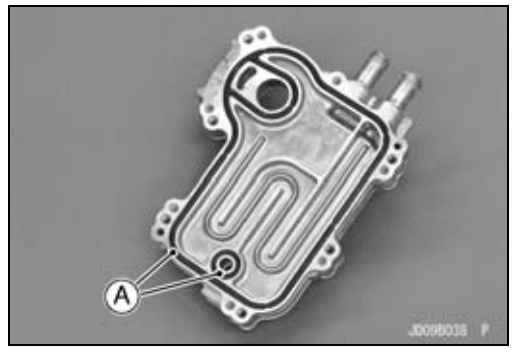



### *Oil Cooler Disassembly*

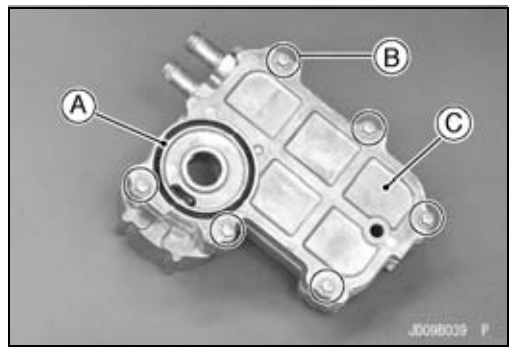
- Remove:
  Oil Cooler (see Oil Cooler Removal)
  Oil Pressure Switch [A]
  Oil Cooler Assembly Bolts [B]
  Outside Oil Cooler Cover [C]



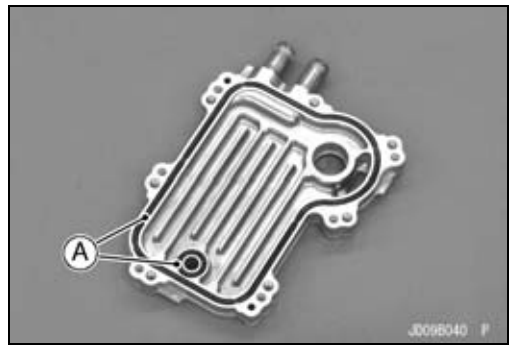

- Remove:
  O-rings [A]




- Turn the oil cooler up side down.
- Remove:
  O-ring [A]
  Oil Cooler Assembly Bolts [B]
  Inside Oil Cooler Cover [C]

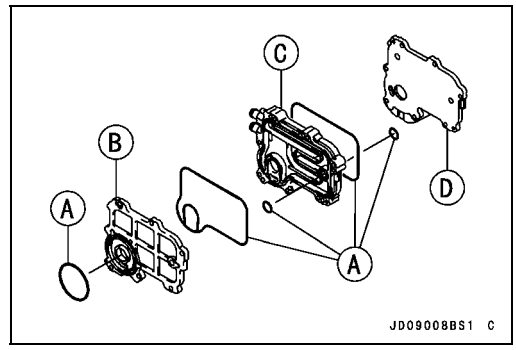



- Remove:
  O-rings [A]



## Oil Cooler

### *Oil Cooler Assembly*




- Replace the O-rings [A] with new ones.
- Apply grease to new O-rings, and fit them on to each groove of the coolers securely.
- Assemble the oil cooler.
  Inside Oil Cooler Cover [B]
  Oil Cooler [C]
  Outside Oil Cooler Cover [D]
- Tighten the oil cooler assembly bolts.

**Torque - Oil Cooler Assembly Bolts: 7.8 N·m (0.80 kgf·m, 69 in·lb)**

- Install the oil cooler (see Oil Cooler Installation).

### *Oil Cooler Inspection*

- Start the engine to check for water and oil leaks.

★If the water and oil leak, replace the O-rings.

**⚠ DANGER**

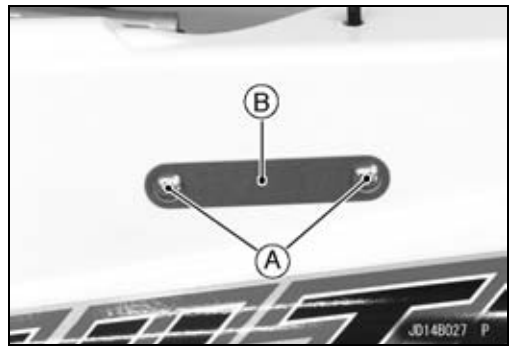
**Exhaust gas contains carbon monoxide, a colorless, odorless poisonous gas. Inhaling carbon monoxide can cause serious brain injury or death. DO NOT run the engine in enclosed areas. Operate only in a well-ventilated area.**

***NOTICE***

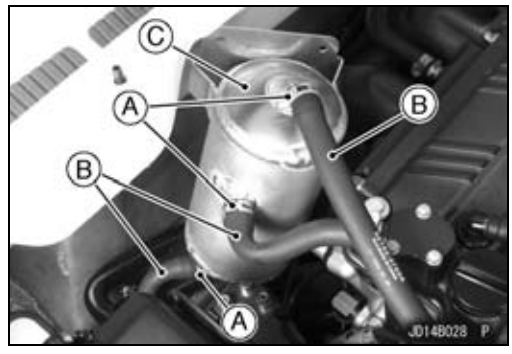
**Operating the engine without cooling water for more than 15 seconds, especially at high rpm, will cause severe engine and exhaust system damage. To avoid engine damage, do not run the engine without providing sufficient cooling water.**

## Oil Separator Tank

### *Oil Separator Tank Removal*




- Remove:
  Seats (see Seat Removal in the Hull/Engine Hood chapter)
  Handrail Plate (see Handrail Plate Removal in the Hull/Engine Hood chapter)
  Oil Separator Tank Mounting Screws [A] and Nuts
  Bracket [B]




- Remove:
  Breather Hose Clamps [A]
  Breather Hoses [B]
  Oil Separator Tank [C]

**NOTE**

○*Hold the hose end to the upward. The oil will flow out if the hose lies at the bottom.*

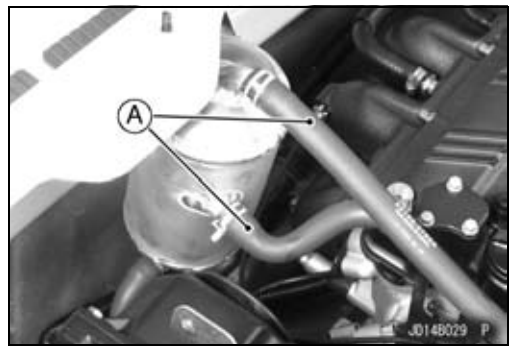
### *Oil Separator Tank Installation*

- When installing the breather hoses, avoid sharp bending, kicking, flattening or twisting, and run the hoses according to Hose Routing section in Appendix chapter.
- Apply a non-permanent locking agent to the oil separator tank mounting nuts, and tighten them.

○Be careful not to drop the nuts.

**Torque - Oil Separator Tank Mounting Nuts: 4.9 N·m (0.50 kgf·m, 43 in·lb)**

### *Blowby Gas System Inspection*



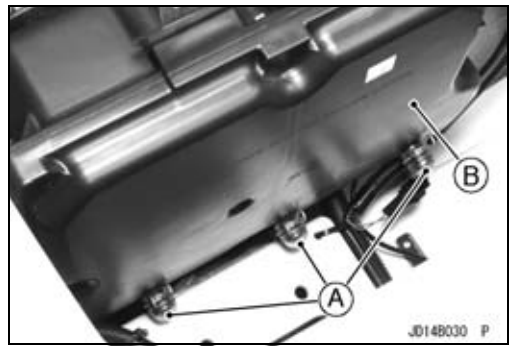

- Be certain that all the hoses are routed without being flattened or kinked, and are connected correctly.

★If they are not, correct them.

- Inspect the breather hoses [A], breather pipes and the air box drain caps for damage or signs of deterioration. Squeeze the hoses. These hoses should not be hard and brittle, nor should be soft or swollen.

★Replace any damaged hoses.

- Check that the hoses and clamps are securely connected.



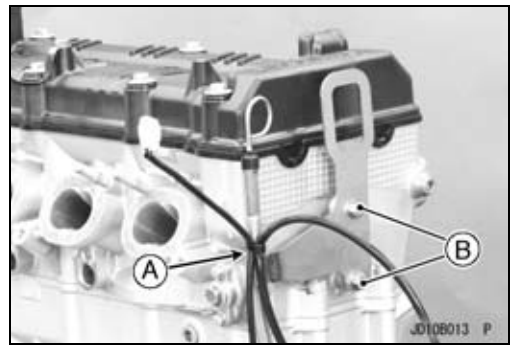

○The drain caps [A] are provided beneath the air box [B]. The drain cap catches the water or oil from the bottom of the air box housing. Usually water or oil does not collect at the bottom of the housing. In the event that water is drawn in through the duct, or if engine oil is blown back, drain the housing.

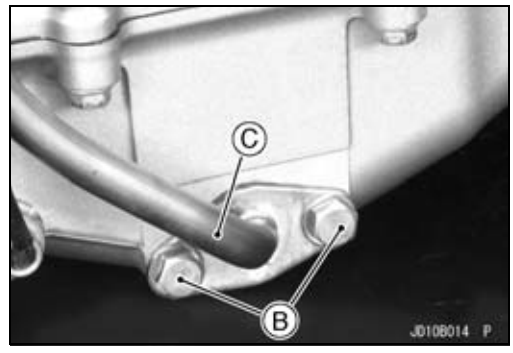
- Pull the drain caps to drain the water or breather oil when changing engine oil.

## Oil Pan

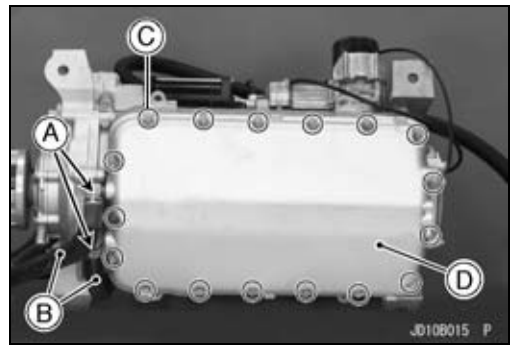
### *Oil Pan Removal*

- Remove:
  Engine Oil (drain, see Engine Oil Change in the Periodic Maintenance chapter)
  Engine (see Engine Removal in the Engine Removal/Installation chapter)
- Turn the engine to the side.
- Cut the band [A].
- Remove the dipstick tube bolts [B] and pull out the dipstick tube [C].




- Remove:
  Clamps [A] and Hoses [B]
  Oil Pan Bolts [C]
  Oil Pan [D]
  Oil Pan Gasket

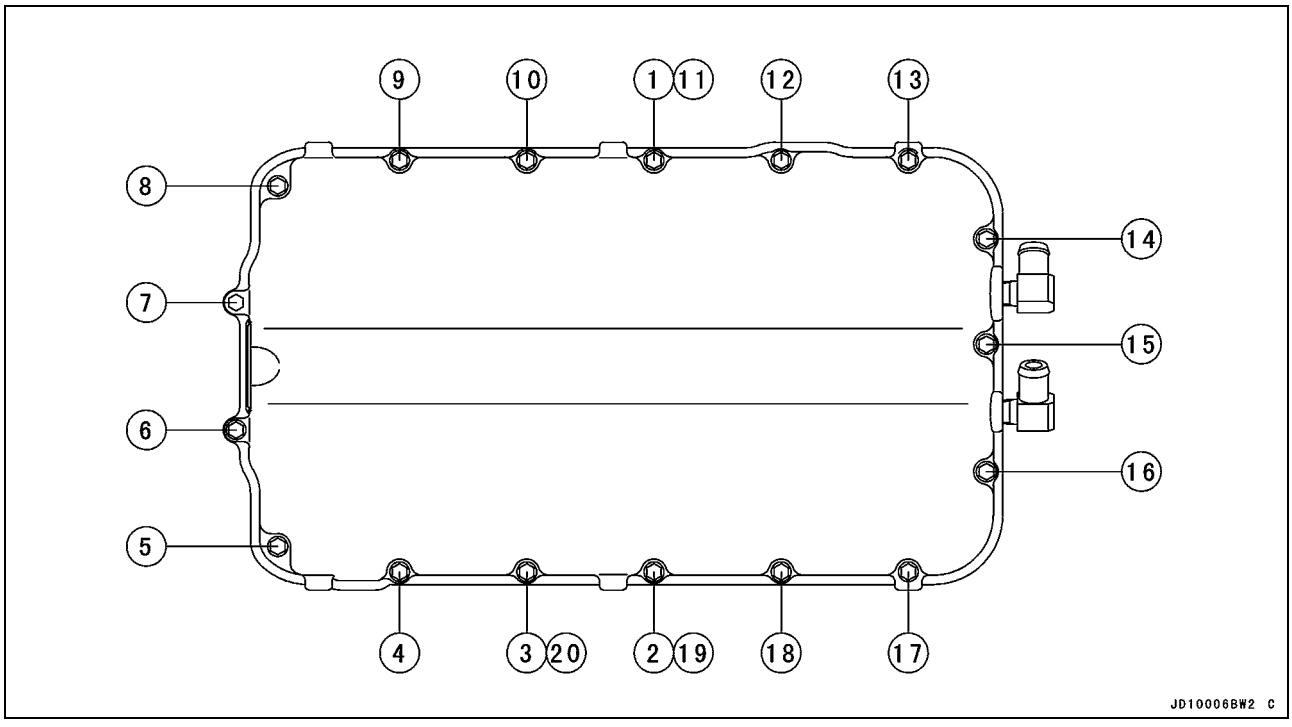


## Oil Pan

### *Oil Pan Installation*

- Replace the oil pan gasket with a new one.
- Install the oil pan [A].
- Tighten the oil pan bolts following the tightening sequence [1 ~ 20].

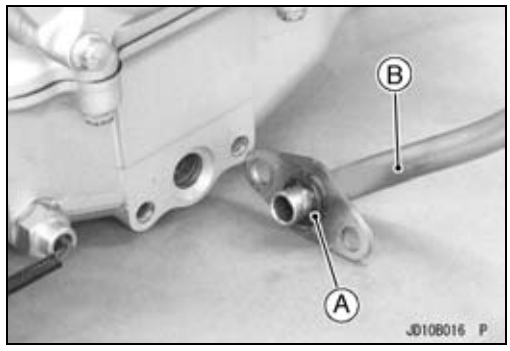
**Torque - Oil Pan Bolts: 20 N·m (2.0 kgf·m, 15 ft·lb)**




- Apply grease to the O-ring [A] on the dipstick tube [B].
- Apply a non-permanent locking agent to the dipstick tube bolts.
- Tighten the dipstick tube bolts temporary.

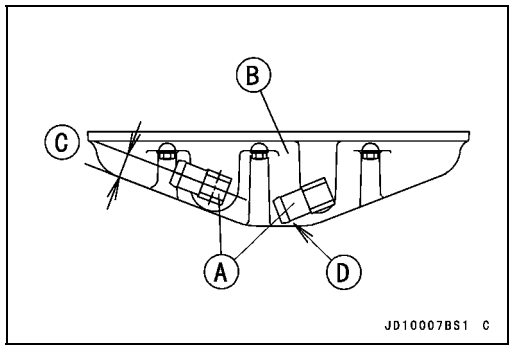
○First, tighten the oil pan side bolts.
○Next, tighten the cylinder head side bolts.

**Torque - Dipstick Tube Bolts: 8.8 N·m (0.90 kgf·m, 78 in·lb)**




- When installing the oil passage joints [A] to the oil pan [B], note the following as shown in the figure.
  Parallel [C] (Oil Passage Joint and Bottom Surface of Oil Pan)
  Do not protrude the oil passage joint from the oil pan [D].
- Apply a non-permanent locking agent to the oil passage joints and tighten them.

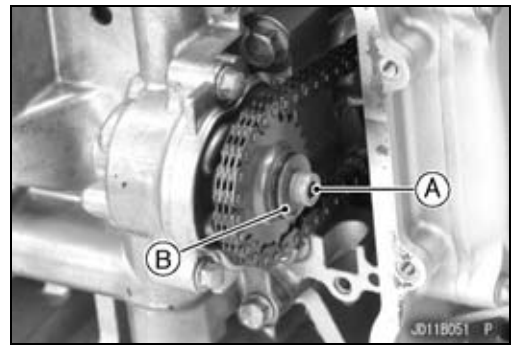
**Torque - Oil Passage Joints: 11 N·m (1.1 kgf·m, 97 in·lb)**



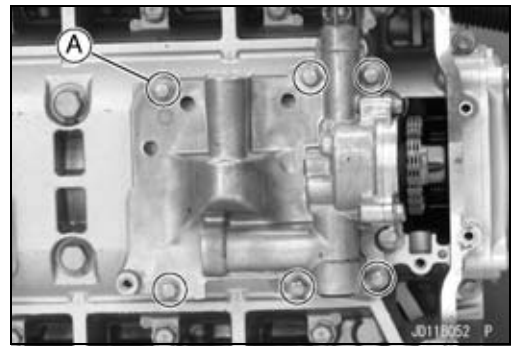
## Oil Pump Sprocket, Oil Pump and Oil Pressure Relief Valve

### *Oil Pump Sprocket Removal*

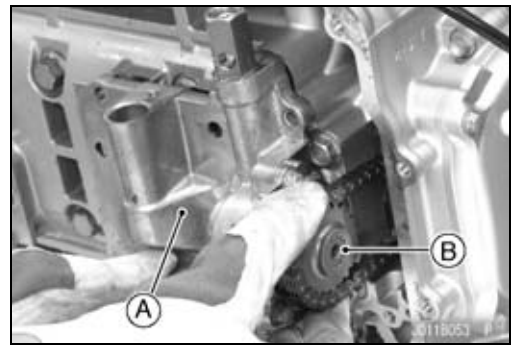
- Drain:
  Engine Oil (see Engine Oil Change in the Periodic Maintenance chapter)
- Remove:
  Engine (see Engine Removal in the Engine Removal/Installation chapter)
  Oil Pan (see Oil Pan Removal)
  Oil Pump Sprocket Bolt [A]
  Washer [B]




- Remove the oil pump body bolts [A].

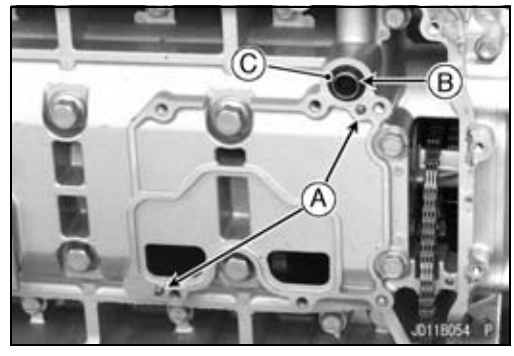



- Pull out the oil pump body [A] and remove the oil pump sprocket [B].




### *Oil Pump Sprocket Installation*

- Check that dowel pins [A] and oil pipe [B] are in place on the crankcase.
- Replace the O-ring [C] with a new one.

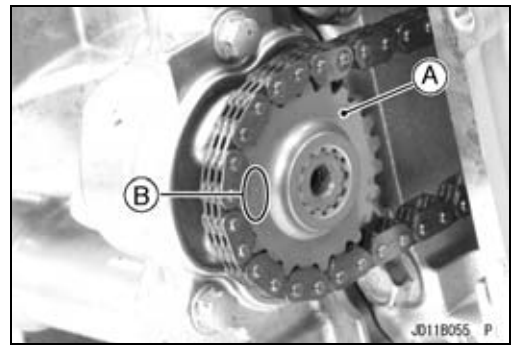



- Engage the oil pump chain with the oil pump sprocket [A].
- Install the oil pump sprocket so that the “620” Mark [B] faces outward on the oil pump body.
- Install the oil pump body.
- Tighten:

**Torque - Oil Pump Body Bolts: 7.8 N·m (0.80 kgf·m, 69 in·lb)**

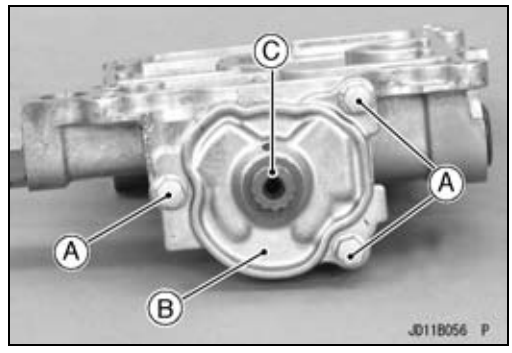
- Apply a non-permanent locking agent (high strength: Loctite 271 equivalent) to the oil pump sprocket bolt.
- Install the oil pump sprocket bolt and washer.
- Tighten:

**Torque - Oil Pump Sprocket Bolt: 16 N·m (1.6 kgf·m, 12 ft·lb)**

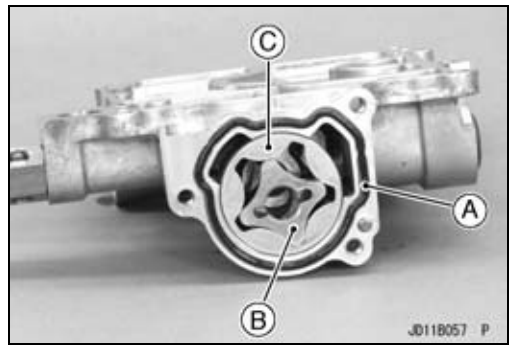


## Oil Pump Sprocket, Oil Pump and Oil Pressure Relief Valve

### *Oil Pump Removal*

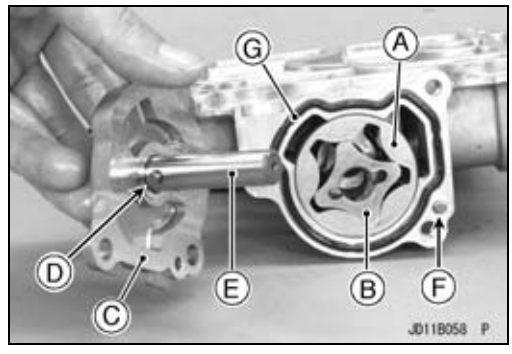



- Drain:
  Engine Oil (see Engine Oil Change in the Periodic Maintenance chapter)
- Remove:
  Engine (see Engine Removal in the Engine Removal/Installation chapter)
  Oil Pan (see Oil Pan Removal)
  Oil Pump Body (see Oil Pump Sprocket Removal)
  Oil Pump Cover Bolts [A]
- Pull out the oil pump cover [B] and oil pump shaft [C].




- Remove:
  O-ring [A]
  Inner Rotor [B]
  Outer Rotor [C]

### *Oil Pump Installation*




- Replace the O-ring with a new one.
- Apply molybdenum disulfide oil solution to the outer and the inner rotors outside.
- Install the outer rotor [A] and inner rotor [B] into the oil pump body.
- Apply molybdenum disulfide oil solution to the shaft.
- Assemble the oil pump cover [C] , pin [D] onto the oil pump shaft [E].
- Be sure the dowel pin [F] is in place in the oil pump body.
- Apply grease to the new O-ring [G] and fit the O-ring to the groove of the oil pump body.
- Insert the shaft assembly.

○Fit the pin into the slot of the inner rotor.

- Fit the oil pump cover and tighten the oil pump cover bolts.

**Torque - Oil Pump Cover Bolts: 7.8 N·m (0.80 kgf·m, 69 in·lb)**

- Install:
  Oil Pump Sprocket (see Oil Pump Sprocket Installation)
  Oil Pan (see Oil Pan Installation)

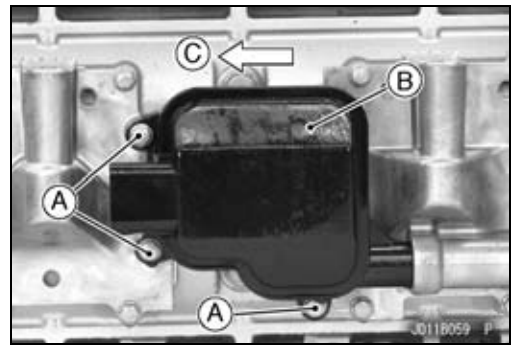
### *Oil Pump Inspection*

- Remove the oil pump parts.
- Visually inspect the oil pump outer, inner rotors and cover.

★If there is any damage or uneven wear, replace the rotors and cover.

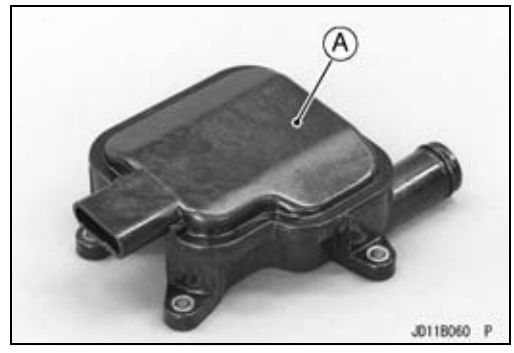
## Oil Pump Sprocket, Oil Pump and Oil Pressure Relief Valve

### *Oil Screen Removal*




- Remove:
  Engine (see Engine Removal in the Engine Removal/Installation chapter)
  Oil Pan (see Oil Pan Removal)
  Oil Screen Bolts [A]
- Pull out the oil screen [B] to the coupling side [C].

### *Oil Screen Installation*



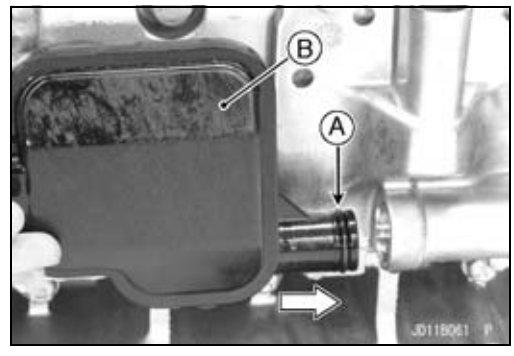

- Clean the oil screen [A] with high flash-point solvent and remove any particles stuck to it.

**⚠ WARNING**

**Gasoline and low flash-point solvents can be flammable and/or explosive and cause severe burns. Clean the screen in a well-ventilated area, and take care that there are no sparks or flame anywhere near the working area; this includes any appliance with a pilot light. Do not use gasoline or a low flash-point solvent to clean the screen.**

**NOTE**

○*While cleaning the screen, check for any metal particles that might indicate internal engine damage.*

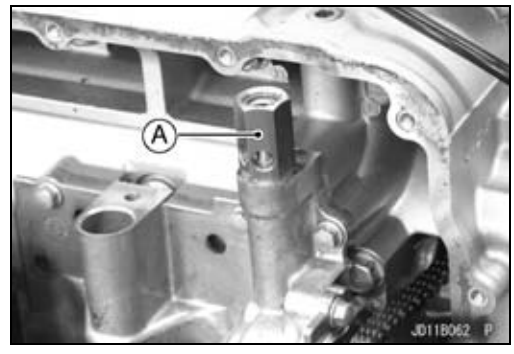



- Replace the O-ring [A] with a new one.
- Apply grease to the O-ring and install it.
- Install the oil screen [B].
- Tighten:

**Torque - Oil Screen Bolts: 7.8 N·m (0.80 kgf·m, 69 in·lb)**

- Install:
  Oil Pan (see Oil Pan Installation)

### *Oil Pressure Relief Valve Inspection*




- Remove:
  Oil Pan (see Oil Pan Removal)
  Oil Pressure Relief Valve [A]

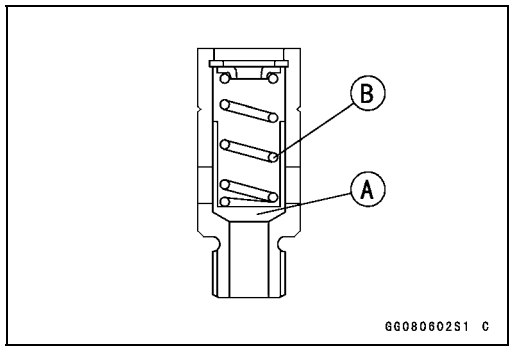
## Oil Pump Sprocket, Oil Pump and Oil Pressure Relief Valve

- Check to see if the valve [A] slides smoothly when pushing it in with a wooden or other soft rod, and see if it comes back to its seat by spring [B] force.

**NOTE**

○*Inspect the valve in its assembled state. Disassembly and assembly may change the valve performance.*

★If any rough spots are found during above inspection, wash the valve clean with a high flash-point solvent and blow out any foreign particles that may be in the valve with compressed air.




**⚠ WARNING**

**Gasoline and low flash-point solvents can be flammable and/or explosive and cause severe burns. Clean the relief valve in a well-ventilated area, and take care that there is no spark or flame anywhere near the working areas. Do not use gasoline or low flash-point solvents to clean the relief valve.**

★If cleaning does not solve the problem, replace the oil pressure relief valve as an assembly. The oil pressure relief valve is precisely made with no allowance for replacement of individual parts.

- Apply a non-permanent locking agent (high strength: Loctite 271 equivalent) to the oil pressure relief valve.

***NOTICE***

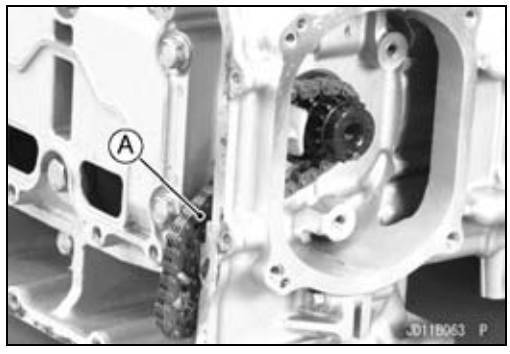
**Excessive non-permanent on the threads may block the oil passage and cause severe engine damage. To prevent the oil passage from becoming blocked, do not apply excessive non-permanent locking agent to the threads.**

- Install the oil pressure relief valve.

**Torque - Oil Pressure Relief Valve: 15 N·m (1.5 kgf·m, 11 ft·lb)**

### *Oil Pump Chain Removal/Installation*

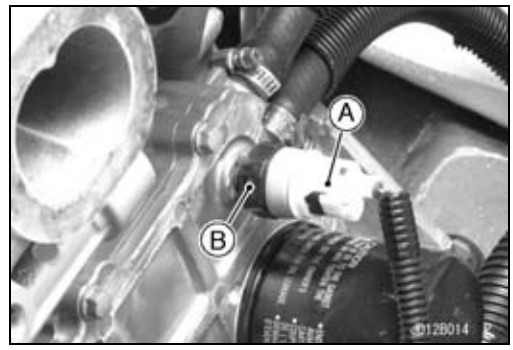
- Remove:
  Camshaft Chain (see Camshaft Chain Removal in the Engine Top End chapter)
  Oil Pump Sprocket (see Oil Pump Sprocket Removal)
- Remove the oil pump chain [A].
- Installation is the reverse of removal.



## Oil Pressure Measurement

### *Oil Pressure Measurement*

- Remove:
  Intake Manifold (see Intake Manifold Removal in the Fuel System (DFI) chapter)
  Oil Pressure Switch Connector [A] (Disconnect)
  Oil Pressure Switch [B]



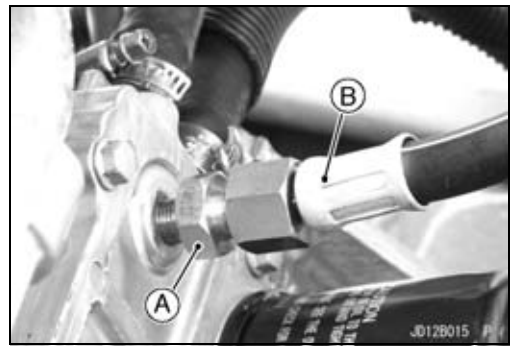

- Install the oil pressure gauge adapter [A] to the switch hole.

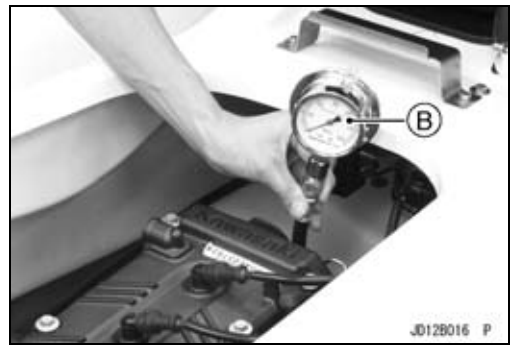
  **Special Tool - Oil Pressure Gauge Adapter, PT 1/8: 57001 -1033**

- Install the oil pressure gauge [B] to the adapter.

  **Special Tool - Oil Pressure Gauge, 10 kgf/cm²: 57001-164**

- Install the removed parts (see appropriate chapters).




- Launch the watercraft.
- Start the engine for several minutes.
- Run the engine at the specified speed, and read the oil pressure gauge.

★If the oil pressure is significantly below the specification, inspect the oil pump and relief valve.

★If the oil pump and relief valve are not at fault, inspect the rest of the lubrication system.

**Oil Pressure**
**Standard: 461 kPa (4.7 kgf/cm², 67 psi) at 3 000 r/min (rpm), Oil Temperature 74°C (165°F)**

- Stop the engine.
- Raise the watercraft to the land.
- Remove the intake manifold (see Intake Manifold Removal in the Fuel System (DFI) chapter).
- Remove the oil pressure gauge and adapter.

**⚠ WARNING**

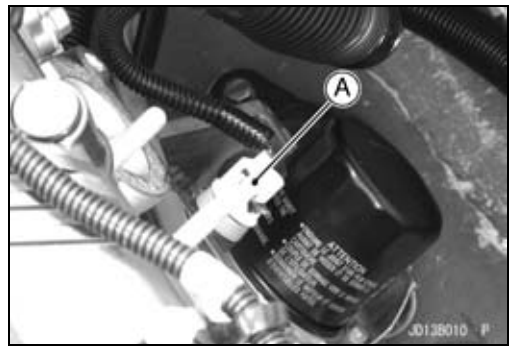
**Hot oil can cause severe burns. Beware of hot engine oil that will drain through the oil passage when the gauge adapter is removed.**

- Install the removed parts (see appropriate chapters).

## Oil Pressure Switch

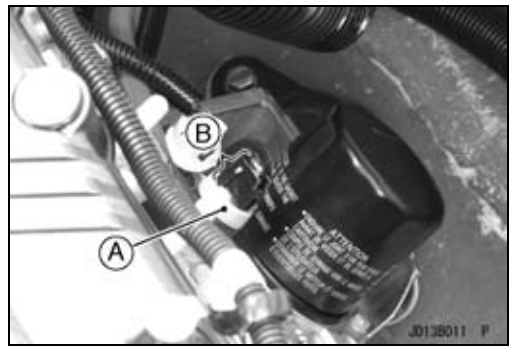
### *Oil Pressure Switch Removal*

- Remove:
  Intake Manifold (see Intake Manifold Removal in the Fuel System (DFI) chapter)
  Oil Pressure Switch Connector [A] (Disconnect)




- Place a rag or cloth under the oil pressure switch [A] and remove the oil pressure switch.

○Do not damage the connect part [B] of the switch.




### *Oil Pressure Switch Installation*

- Apply a non-permanent locking agent to the threads of the oil pressure switch and tighten it.

  **Torque - Oil Pressure Switch: 15 N·m (1.5 kgf·m, 11 ft·lb)**

- Connect the oil pressure switch connector.
- Install the removed parts (see appropriate chapters).

# Exhaust System

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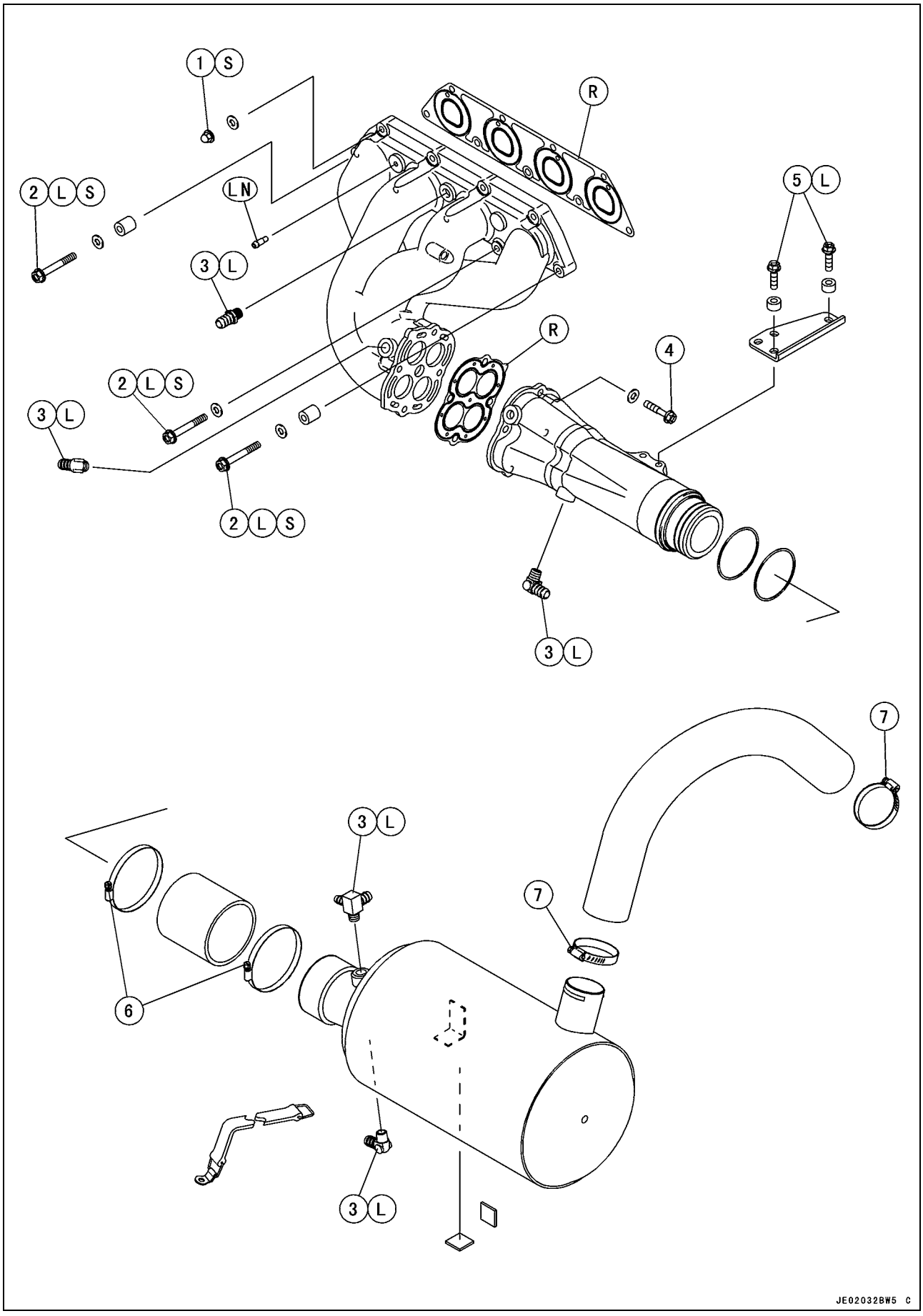
# 5-2 EXHAUST SYSTEM

## Exploded View



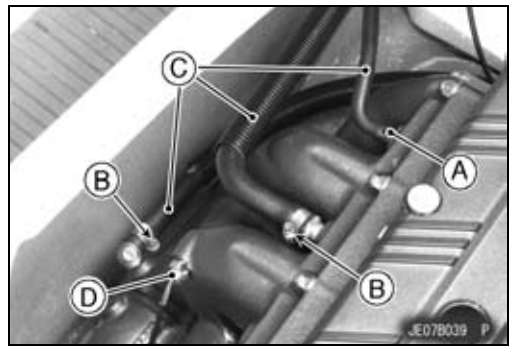
## Exploded View

| No. | Fastener | Torque | | | Remarks |
|---|---|---|---|---|---|
| | | N·m | kgf·m | ft·lb | |
| 1 | Exhaust Manifold Mounting Nuts | 25 | 2.5 | 18 | S |
| 2 | Exhaust Manifold Mounting Bolts | 25 | 2.5 | 18 | L, S |
| 3 | Water Hose Joints | 11 | 1.1 | 97 in·lb | L |
| 4 | Exhaust Pipe Mounting Bolts | 45 | 4.6 | 33 | |
| 5 | Exhaust Pipe Mounting Plate Bolts | 30 | 3.1 | 22 | L |
| 6 | Front Exhaust Hose Clamp Screws | 5.0 | 0.51 | 44 in·lb | |
| 7 | Rear Exhaust Hose Clamp Screws | 5.0 | 0.51 | 44 in·lb | |

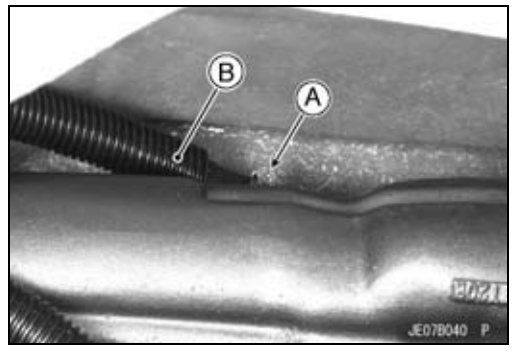
L: Apply a non-permanent locking agent.
LN: Apply a non-permanent locking agent (High Strength).
R: Replacement Parts
S: Follow the specified tightening sequence.

## Exhaust Manifold

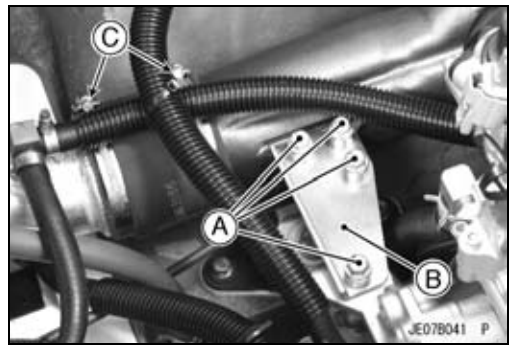
### *Exhaust Manifold Removal*



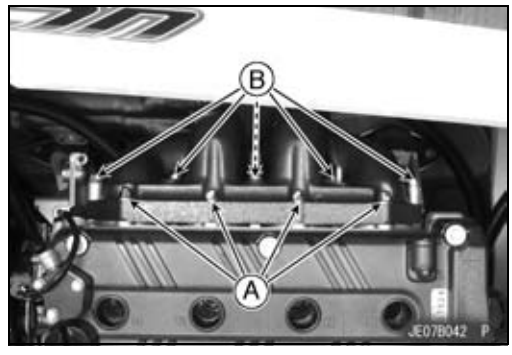

- Remove:
  Seats (see Seat Removal in the Hull/Engine Hood chapter)
  Handrail Plate (see Handrail Plate Removal in the Hull/Engine Hood chapter)
  Oil Separator Tank (see Oil Separator Tank Removal in the Engine Lubrication System chapter)
  Band [A] (Cut)
  Clamp Screws [B] (Loosen)
  Water Hoses [C]
  Water Temperature Sensor [D] (see Water Temperature Sensor Removal/Installation in the Fuel System (DFI) chapter)




- Loosen the clamp screw [A], and remove the water hose [B].




- Remove:
  Bolts [A] and Collars
  Exhaust Pipe Mounting Plate [B]
  Front Exhaust Hose Clamp Screws [C] (Loosen)




- Remove:
  Exhaust Manifold Mounting Nuts [A] and Washers
  Exhaust Manifold Mounting Bolts [B], Washers and Collars
- Remove the exhaust manifold toward the front.

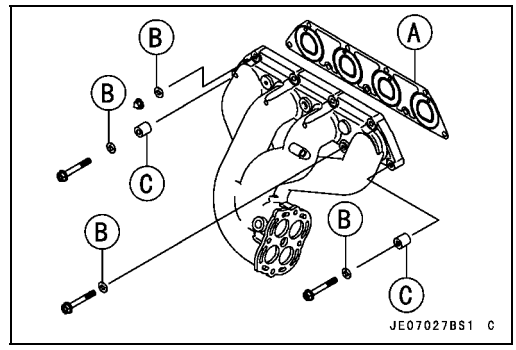
### *Exhaust Manifold Installation*

**NOTE**

○*Unhook the rubber strap and remove the front exhaust hose from the water box muffler for easier installation of the exhaust manifold, and after connecting the water box muffler to the exhaust pipe, hook the rubber strap and install the hose.*

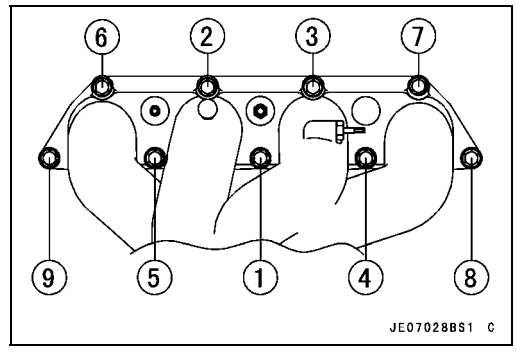
## Exhaust Manifold

- Replace the exhaust manifold gasket [A] with a new one.
- Install the exhaust manifold, washers [B] and collars [C] as shown in the figure.
- Apply a non-permanent locking agent to the exhaust manifold mounting bolts.




- Tighten the exhaust manifold mounting nuts and bolts following the specified tightening sequence.

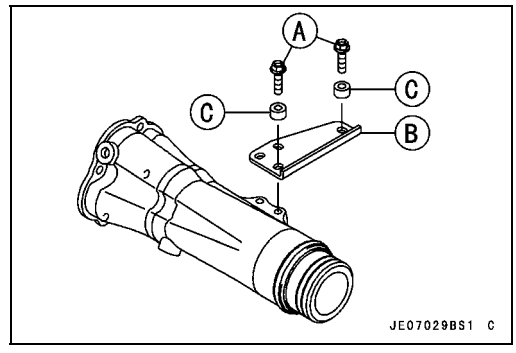
**Torque - Exhaust Manifold Mounting Nuts: 25 N·m (2.5 kgf·m, 18 ft·lb)**
**Exhaust Manifold Mounting Bolts: 25 N·m (2.5 kgf·m, 18 ft·lb)**




- Apply a non-permanent locking agent to the exhaust pipe mounting plate bolts [A] and install the plate [B] and collars [C].
- Tighten:

**Torque - Exhaust Pipe Mounting Plate Bolts: 30 N·m (3.1 kgf·m, 22 ft·lb)**

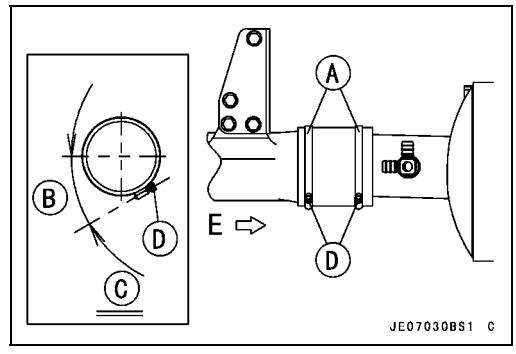
- Connect the water box muffler to the exhaust pipe after binding the two rings with the paper tape (see Exhaust Pipe Installation).




- Check the hose routing and clamp screw position (see Cable, Wire, and Hose Routing section in the Appendix chapter).
- Install the clamps [A] as shown in the figure.
  30° [B]
  View E [C]
- Tighten:

**Torque - Front Exhaust Hose Clamp Screws [D]: 5.0 N·m (0.51 kgf·m, 44 in·lb)**

- Install the removed parts (see appropriate chapters).



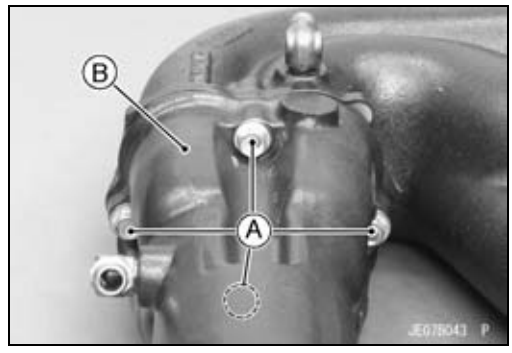

### *Exhaust Manifold Cleaning and Inspection*

- Remove the exhaust manifold parts (see Exhaust Manifold Removal).
- Clean the carbon deposits out of the exhaust passages with a blunt, round edged tool.
- Flush foreign matter out of the water passages with fresh water.
- Check the insides of the water passages for corrosion.
- Check the gasket surfaces for nicks or other damage.

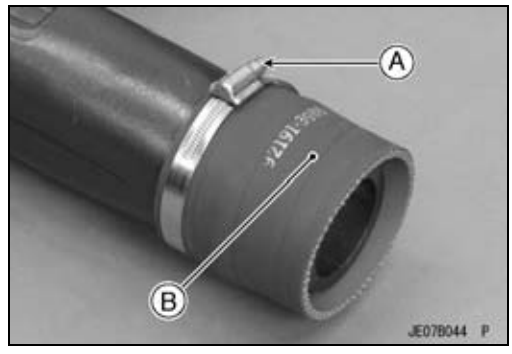
★If there is excessive corrosion or if the gasket surfaces are so badly damaged that they will not seal properly, replace the part.

## Exhaust Pipe

### *Exhaust Pipe Removal*

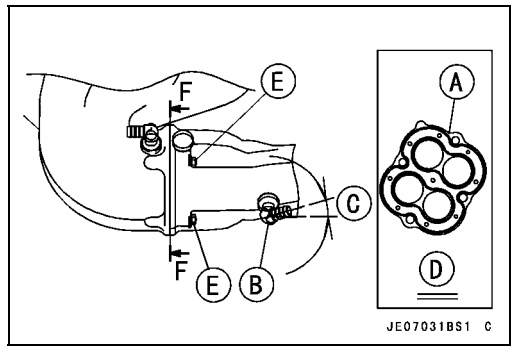



- Remove the exhaust manifold with exhaust pipe (see Exhaust Manifold Removal).
- Remove the exhaust pipe mounting bolts [A] and washers.
- Remove the exhaust pipe [B].




- Loosen the clamp screw [A].
- Remove the front exhaust hose [B] and the two rings.

### *Exhaust Pipe Installation*

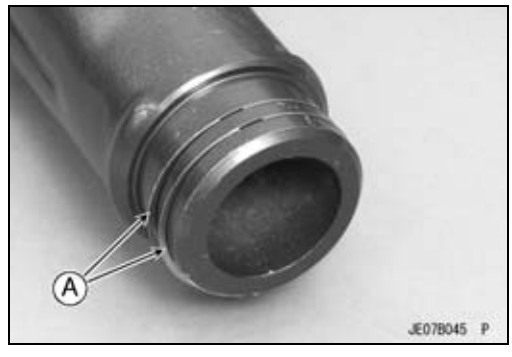



- Replace the exhaust pipe gasket with a new one.
- Apply a non-permanent locking agent to the water hose joint.
- Install the new gasket [A] and the water hose joint [B] as shown in the figure.
  30° [C]
  Section F-F [D]
- Tighten:

  **Torque - Water Hose Joint: 11 N·m (1.1 kgf·m, 97 in·lb)**

- Install the exhaust pipe mounting bolts and washers as follows, and tighten them.

  **Torque - Exhaust Pipe Mounting Bolts [E]: 45 N·m (4.6 kgf·m, 33 ft·lb)**

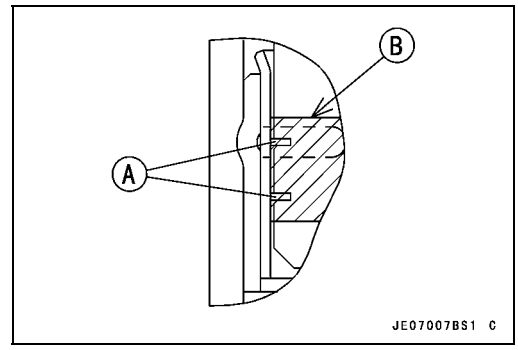



- Install the two rings [A] in the ring grooves of the exhaust pipe.

★If the two rings are damaged or warped, replace the rings.

## Exhaust Pipe

- Bind the two rings [A] securely by putting the paper tape [B] around the rings so that it is easy to insert the water box muffler into the exhaust pipe. The paper tape can be burned out soon after firing.
- Install the front exhaust hose to the exhaust pipe.




### *Exhaust Pipe Cleaning and Inspection*

- Remove the exhaust pipe parts (see Exhaust Pipe Removal).
- Clean the carbon deposits out of the exhaust passages with a blunt, round edged tool.
- Flush foreign matter out of the water passages with fresh water.
- Check the insides of the water passages for corrosion.
- Check the gasket surfaces for nicks or other damage.

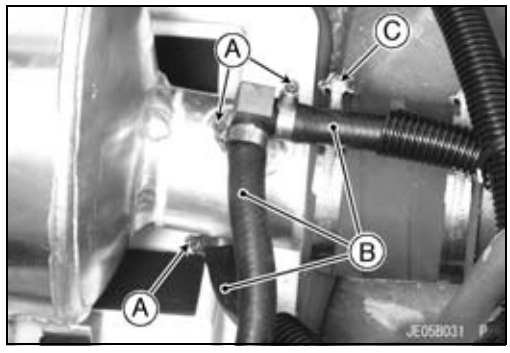
★If there is excessive corrosion or if the gasket surfaces are so badly damaged that they will not seal properly, replace the part.

## Water Box Muffler

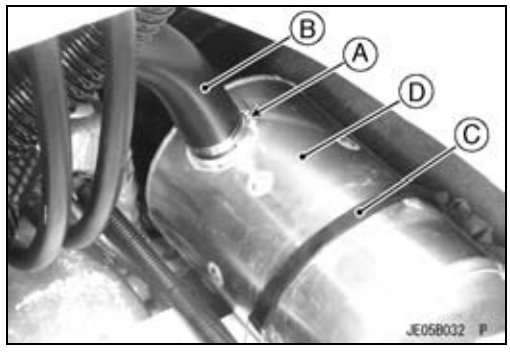
### *Water Box Muffler Removal*

- Remove:
  Oil Separator Tank (see Oil Separator Tank Removal in the Engine Lubrication System chapter)
  Air Box (see Air Box Removal in the Fuel System (DFI) chapter)

- Loosen the clamp screws [A], and remove the water hoses [B].
- Loosen the front exhaust hose clamp screw [C].

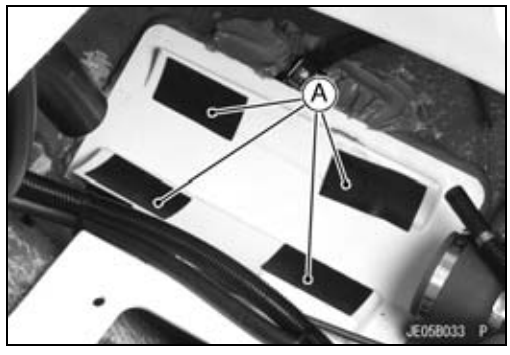



- Loosen the clamp screw [A], and remove the rear exhaust hose [B].
- Unhook the rubber strap [C] from the water box muffler [D].
- Remove the water box muffler backward.




### *Water Box Muffler Installation*

- Be sure the dampers [A] on the hull are in place.

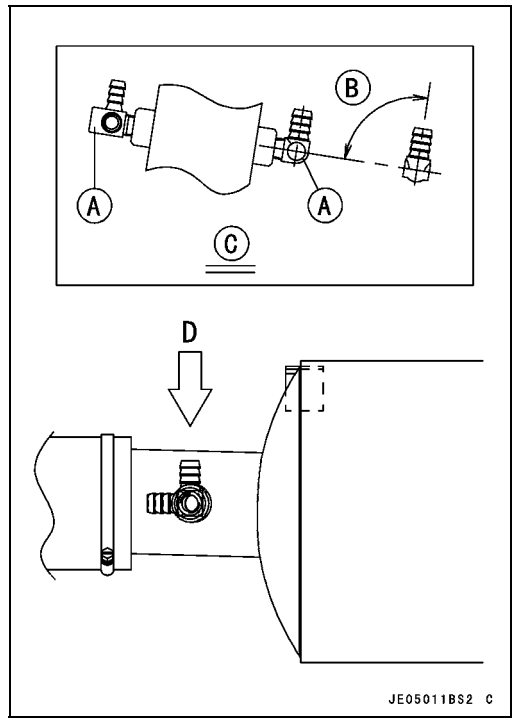



- Be sure the dampers [A] on the water box muffler are in place.

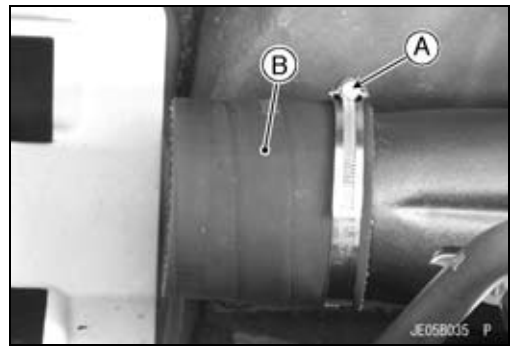
## Water Box Muffler

- Apply a non-permanent locking agent to the water hose joints.
- Install the water hose joints [A] as shown in the figure.
  90° [B]
  View D [C]
- Tighten:

**Torque - Water Hose Joints: 11 N·m (1.1 kgf·m, 97 in·lb)**

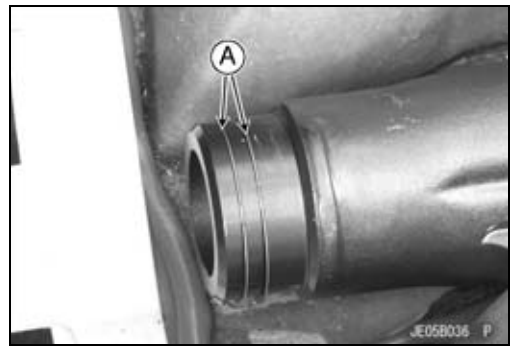



- Loosen the clamp screw [A], and remove the front exhaust hose [B].

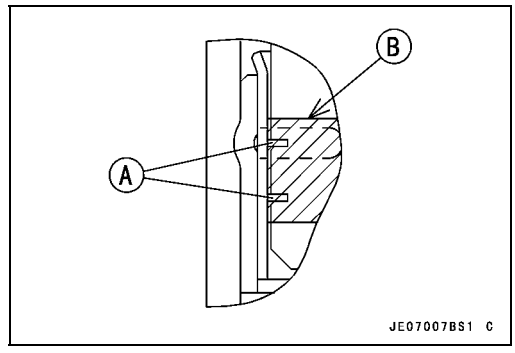



- Make sure the two rings [A] are installed to the correct position.

★If the rings are damaged or warped, replace the rings.




- Bind the two rings [A] by putting the paper tape [B] around the rings. The paper tape can be burned out soon after firing.
- Install the front exhaust hose to the exhaust pipe.



## Water Box Muffler

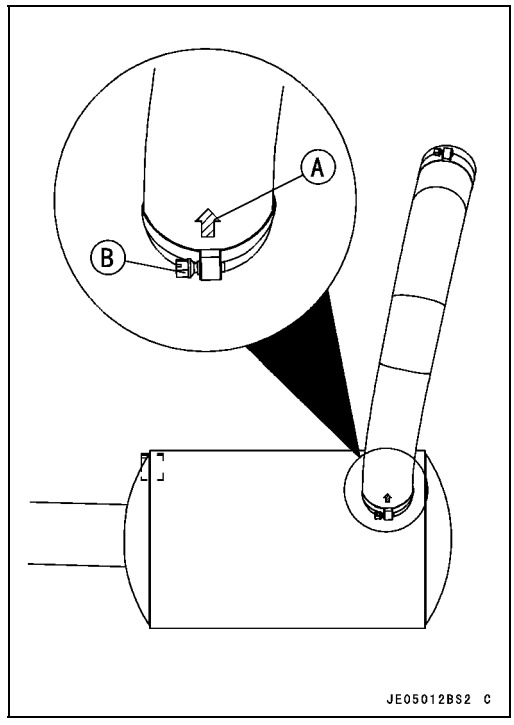
- Install the water box muffler to the exhaust pipe.
- Install the rear exhaust hose so that the arrow mark [A] are left side.
- Install the clamp [B] as shown in the figure.
- Tighten:

**Torque - Rear Exhaust Hose Clamp Screw: 5.0 N·m (0.51 kgf·m, 44 in·lb)**

- For other clamps, tighten the clamp securing the front exhaust hose, noting its screw position, and check the hose routing and clamp screw position (see Cable, Wire, and Hose Routing section in the Appendix chapter).

**Torque - Front Exhaust Hose Clamp Screws: 5.0 N·m (0.51 kgf·m, 44 in·lb)**

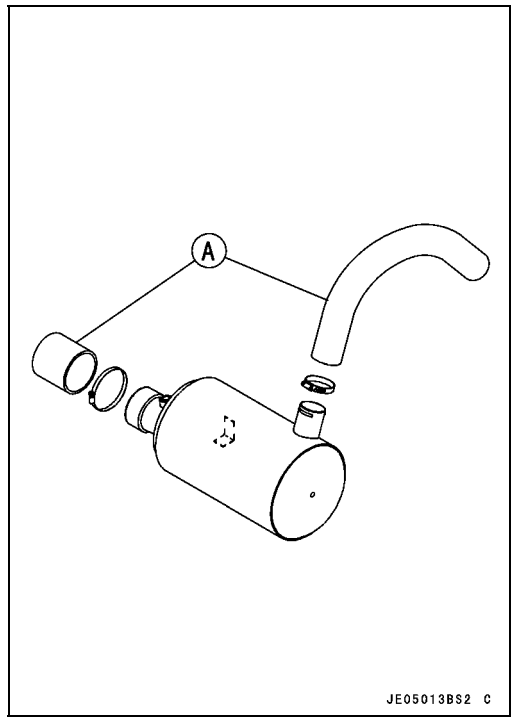
- Install the removed parts (see appropriate chapters).




### *Exhaust Hose Inspection*

- Remove the exhaust hoses [A] (see Water Box Muffler Removal).
- Check the exhaust hoses for damage caused by excessive heat.

★If there is heat damage to the exhaust hose, check the cooling system for blockage (see Cooling and Bilge System Flow Diagram section in the Cooling and Bilge Systems chapter).



# Engine Top End

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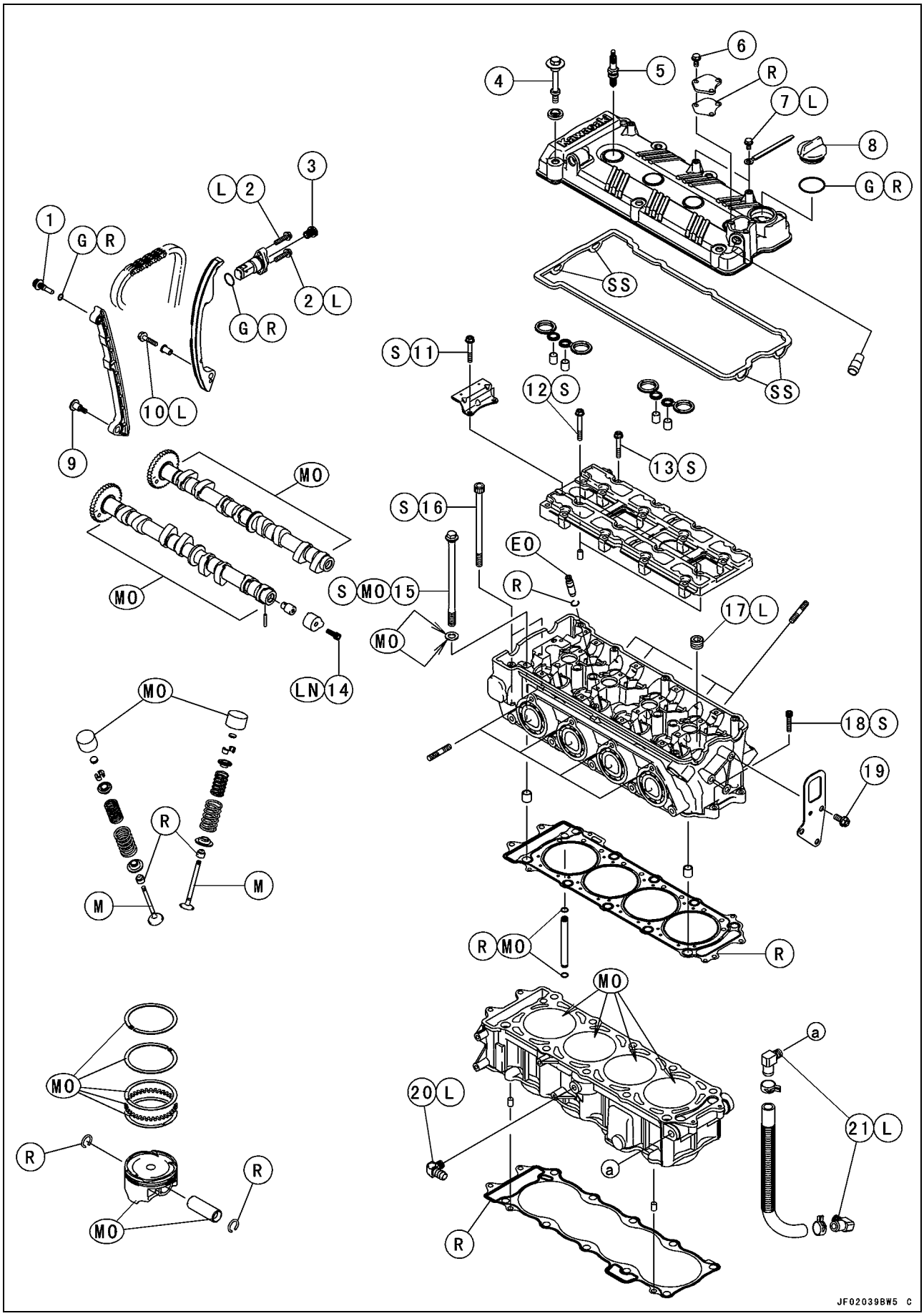
## Exploded View



## Exploded View

| No. | Fastener | Torque | | | Remarks |
|---|---|---|---|---|---|
| | | N·m | kgf·m | ft·lb | |
| 1 | Exhaust Side Camshaft Chain Guide Bolt (Upper) | 25 | 2.5 | 18 | |
| 2 | Camshaft Chain Tensioner Mounting Bolts | 10 | 1.0 | 89 in·lb | L |
| 3 | Camshaft Chain Tensioner Cap Bolt | 20 | 2.0 | 15 | |
| 4 | Cylinder Head Cover Bolts | 10 | 1.0 | 89 in·lb | |
| 5 | Spark Plugs | 13 | 1.3 | 115 in·lb | |
| 6 | Breather Plate Bolts | 7.8 | 0.80 | 69 in·lb | |
| 7 | Harness Clamp Mounting Bolts | 8.8 | 0.90 | 78 in·lb | L |
| 8 | Oil Filler Cap | – | – | – | Hand-tighten |
| 9 | Exhaust Side Camshaft Chain Guide Bolt (Lower) | 12 | 1.2 | 106 in·lb | |
| 10 | Intake Side Camshaft Chain Guide Bolt | 12 | 1.2 | 106 in·lb | L |
| 11 | Upper Camshaft Chain Guide Bolts | 12 | 1.2 | 106 in·lb | S |
| 12 | Camshaft Cap Bolts (L = 50 mm) | 12 | 1.2 | 106 in·lb | S |
| 13 | Camshaft Cap Bolts (L = 40 mm) | 12 | 1.2 | 106 in·lb | S |
| 14 | Camshaft Position Sensor Rotor Bolt | 12 | 1.2 | 106 in·lb | LN |
| 15 | Cylinder Head Bolts (M11, First) | 23 | 2.3 | 17 | MO, S |
| | Cylinder Head Bolts (M11, Final) | 60 | 6.1 | 44 | MO, S |
| 16 | Cylinder Head Bolts (M7) | 20 | 2.0 | 15 | S |
| 17 | Water Jacket Plugs | 19.6 | 2.0 | 14 | L |
| 18 | Cylinder Head Bolts (M6) | 12 | 1.2 | 106 in·lb | S |
| 19 | Engine Hook Bolts | 20 | 2.0 | 15 | |
| 20 | Water Hose Joint | 11 | 1.1 | 97 in·lb | L |
| 21 | Oil Passage Joints | 11 | 1.1 | 97 in·lb | L |

EO: Apply engine oil.
G: Apply grease.
L: Apply a non-permanent locking agent.
LN: Apply a non-permanant locking agent (High Strength: Loctite 271 equivalent).
M: Apply molybdenum disulfide grease.
MO: Apply molybdenum disulfide oil solution.
(mixture of engine oil and molybdenum disulfide grease in a weight ratio is 10:1)
R: Replacement Parts
S: Follow the specified tightening sequence.
SS: Apply silicone sealant.

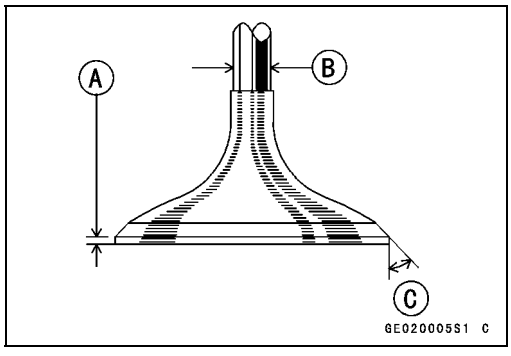
## Specifications

| Item | Standard | Service Limit |
|---|---|---|
| **Camshafts** | | |
| Cam Height: | | |
| Exhaust | 36.143 ~ 36.257 mm (1.4229 ~ 1.4274 in.) | 36.04 mm (1.419 in.) |
| Intake | 36.443 ~ 36.557 mm (1.4348 ~ 1.4392 in.) | 36.34 mm (1.431 in.) |
| Camshaft Journal, Camshaft Cap Clearance | 0.028 ~ 0.071 mm (0.0011 ~ 0.0028 in.) | 0.16 mm (0.0063 in.) |
| Camshaft Journal Diameter | 23.950 ~ 23.972 mm (0.9429 ~ 0.9438 in.) | 23.92 mm (0.942 in.) |
| Camshaft Bearing Inside Diameter | 24.000 ~ 24.021 mm (0.9449 ~ 0.9457 in.) | 24.08 mm (0.948 in.) |
| Camshaft Runout | TIR 0.02 mm (0.0008 in.) or less | TIR 0.1 mm (0.004 in.) |
| **Cylinder Head** | | |
| Cylinder Compression | (Usable Range)<br>1 190 ~ 1 795 kPa (12.1 ~ 18.3 kgf/cm², 173 ~ 260 psi) at 430 r/min (rpm) | – – – |
| Cylinder Head Warp | – – – | 0.05 mm (0.0020 in.) |
| **Valves** | | |
| Valve Clearance: | | |
| Exhaust | 0.22 ~ 0.31 mm (0.0087 ~ 0.0122 in.) | – – – |
| Intake | 0.15 ~ 0.24 mm (0.0059 ~ 0.0094 in.) | – – – |
| Valve Head Thickness: | | |
| Exhaust | 0.8 mm (0.031 in.) | 0.4 mm (0.016 in.) |
| Intake | 0.5 mm (0.020 in.) | 0.3 mm (0.012 in.) |
| Valve Stem Bend | TIR 0.01 mm (0.0004 in.) or less | TIR 0.05 mm (0.002 in.) |
| Valve Stem Diameter: | | |
| Exhaust | 4.955 ~ 4.970 mm (0.1951 ~ 0.1957 in.) | 4.94 mm (0.194 in.) |
| Intake | 4.975 ~ 4.990 mm (0.1959 ~ 0.1965 in.) | 4.96 mm (0.195 in.) |
| Valve Guide Inside Diameter: | | |
| Exhaust | 5.000 ~ 5.012 mm (0.1969 ~ 0.1973 in.) | 5.08 mm (0.200 in.) |
| Intake | 5.000 ~ 5.012 mm (0.1969 ~ 0.1973 in.) | 5.08 mm (0.200 in.) |
| Valve/Valve Guide Clearance (Wobble Method): | | |
| Exhaust | 0.09 ~ 0.17 mm (0.0035 ~ 0.0067 in.) | 0.35 mm (0.014 in.) |
| Intake | 0.03 ~ 0.11 mm (0.0012 ~ 0.0043 in.) | 0.29 mm (0.011 in.) |
| Valve Seat Cutting Angle | 32°, 45°, 55°, 60° | – – – |
| Valve Seating Surface: | | |
| Outside Diameter: | | |
| Exhaust | 27.6 ~ 27.8 mm (1.087 ~ 1.094 in.) | – – – |
| Intake | 32.6 ~ 32.8 mm (1.283 ~ 1.291 in.) | – – – |
| Width: | | |
| Exhaust | 0.8 ~ 1.2 mm (0.031 ~ 0.047 in.) | – – – |
| Intake | 0.5 ~ 1.0 mm (0.020 ~ 0.039 in.) | – – – |
| Valve Spring Free Length: | | |
| Exhaust (Inner) | 38.1 mm (1.50 in.) | 36.7 mm (1.44 in.) |
| Exhaust (Outer) | 46.0 mm (1.81 in.) | 44.5 mm (1.75 in.) |
| Intake (Inner) | 38.0 mm (1.50 in.) | 36.5 mm (1.44 in.) |

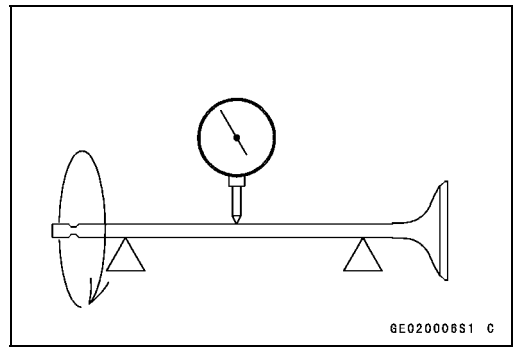
## Specifications

| Item | Standard | Service Limit |
|---|---|---|
| Intake (Outer) | 45.8 mm (1.80 in.) | 44.2 mm (1.74 in.) |
| **Cylinder, Piston** | | |
| Cylinder Inside Diameter | 82.994 ~ 83.006 mm (3.2675 ~ 3.2679 in.) | 83.10 mm (3.272 in.) |
| Piston Diameter | 82.919 ~ 82.934 mm (3.2645 ~ 3.2651 in.) | 82.77 mm (3.259 in.) |
| Piston/Cylinder Clearance | 0.060 ~ 0.087 mm (0.0024 ~ 0.0034 in.) | – – – |
| Piston Ring/Groove Clearance: | | |
| Top | 0.03 ~ 0.07 mm (0.0012 ~ 0.0028 in.) | 0.17 mm (0.0067 in.) |
| Second | 0.02 ~ 0.06 mm (0.0008 ~ 0.0024 in.) | 0.16 mm (0.0063 in.) |
| Piston Ring Groove Width: | | |
| Top | 0.92 ~ 0.94 mm (0.0362 ~ 0.0370 in.) | 1.02 mm (0.0402 in.) |
| Second | 1.01 ~ 1.03 mm (0.0398 ~ 0.0406 in.) | 1.11 mm (0.0437 in.) |
| Piston Ring Thickness: | | |
| Top | 0.87 ~ 0.89 mm (0.0343 ~ 0.0350 in.) | 0.80 mm (0.0315 in.) |
| Second | 0.97 ~ 0.99 mm (0.0382 ~ 0.0390 in.) | 0.90 mm (0.0354 in.) |
| Piston Ring End Gap: | | |
| Top | 0.25 ~ 0.40 mm (0.0098 ~ 0.0157 in.) | 0.7 mm (0.028 in.) |
| Second | 0.40 ~ 0.55 mm (0.0157 ~ 0.0217 in.) | 0.8 mm (0.031 in.) |

**Valve Head Thickness**



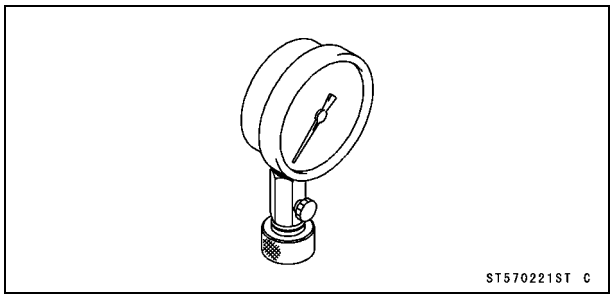

**Valve Stem Bend**



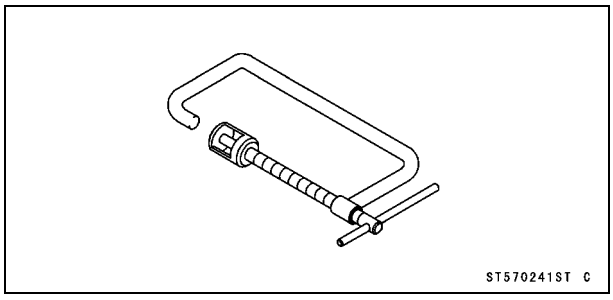

Valve Head Thickness [A]
Valve Stem Diameter [B]
45° [C]

## Special Tools and Sealant

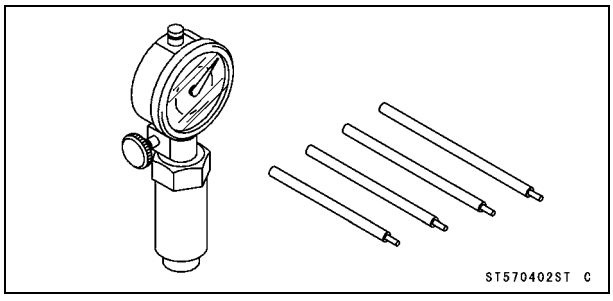
**Compression Gauge, 20 kgf/cm²:**
**57001-221**



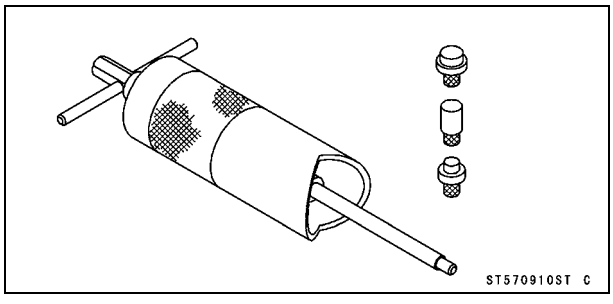

**Valve Spring Compressor Assembly:**
**57001-241**



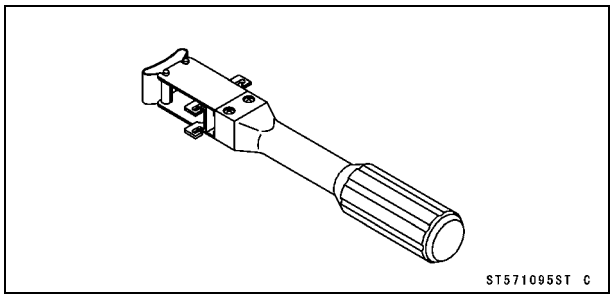

**Top Dead Center Finder:**
**57001-402**



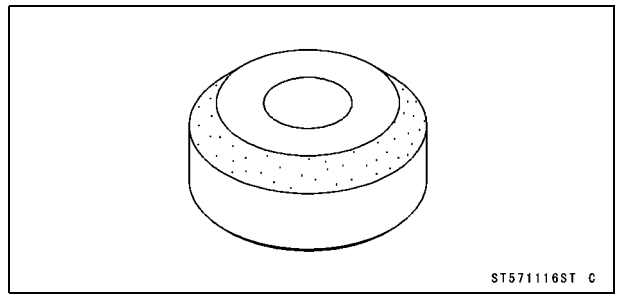

**Piston Pin Puller Assembly:**
**57001-910**



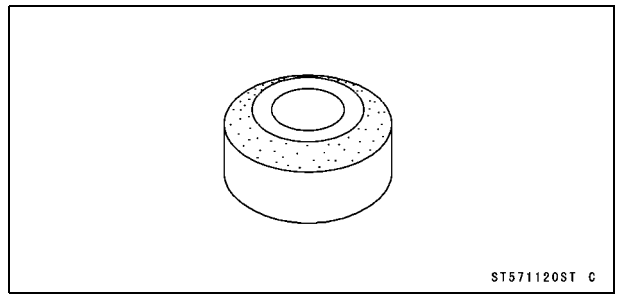

**Piston Ring Compressor Grip:**
**57001-1095**



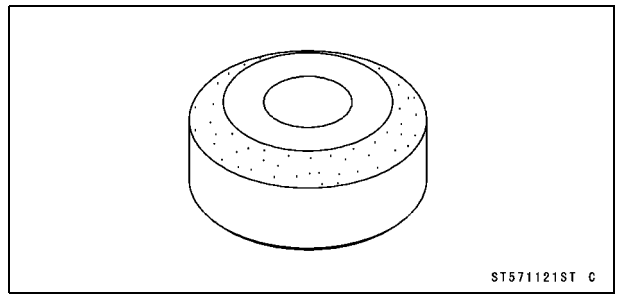

**Valve Seat Cutter, 45° - $\phi$35:**
**57001-1116**



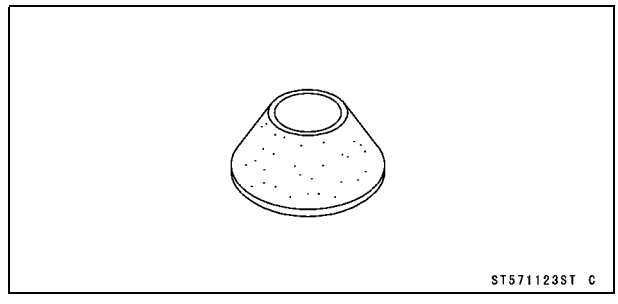

**Valve Seat Cutter, 32° - $\phi$30:**
**57001-1120**



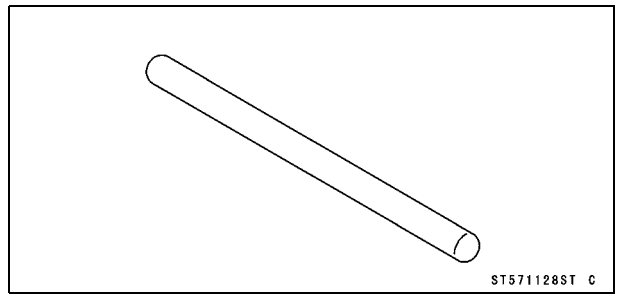

**Valve Seat Cutter, 32° - $\phi$35:**
**57001-1121**




**Valve Seat Cutter, 60° - $\phi$30:**
**57001-1123**

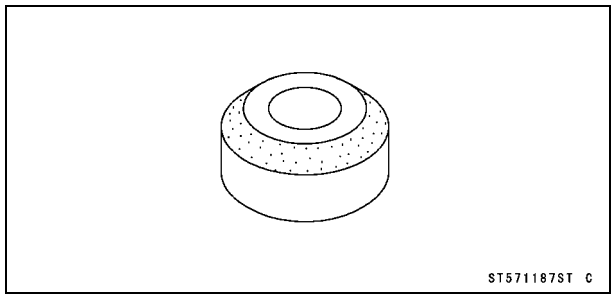



**Valve Seat Cutter Holder Bar:**
**57001-1128**

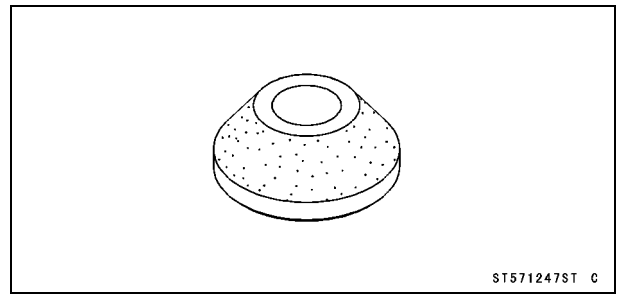


## Special Tools and Sealant

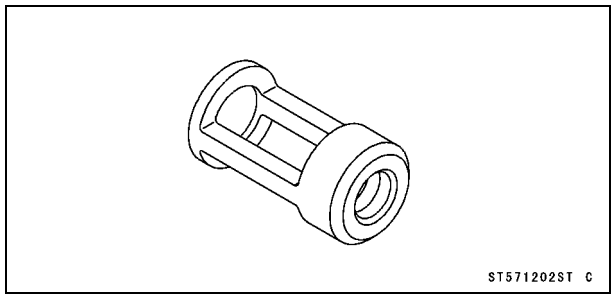
**Valve Seat Cutter, 45° - $\phi$30:**
**57001-1187**



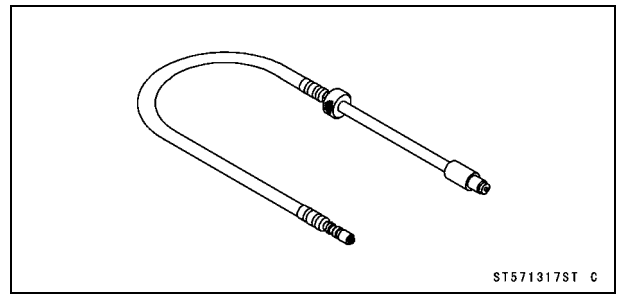

**Valve Seat Cutter, 55° - $\phi$35:**
**57001-1247**



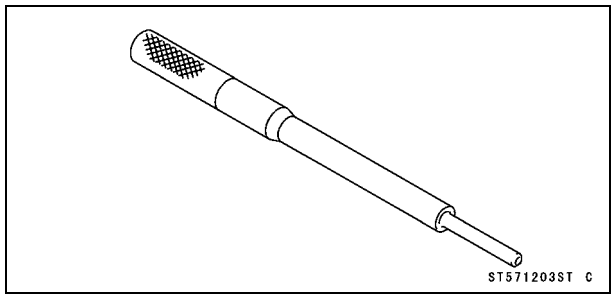

**Valve Spring Compressor Adapter, $\phi$22:**
**57001-1202**



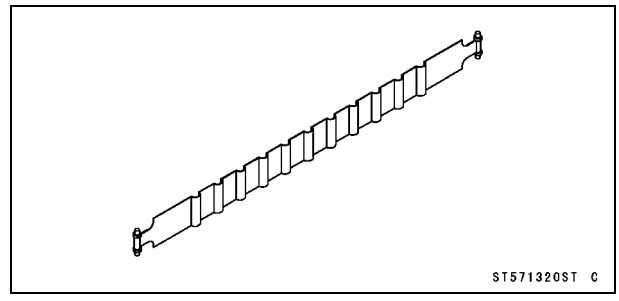

**Compression Gauge Adapter, M10 × 1.0:**
**57001-1317**



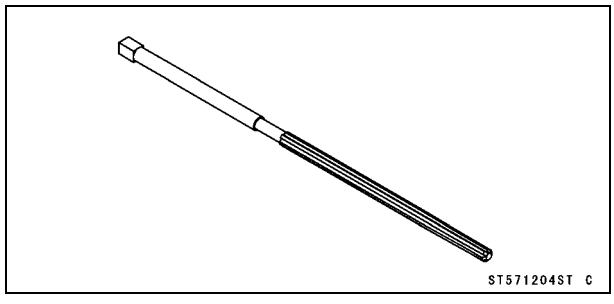

**Valve Guide Arbor, $\phi$5:**
**57001-1203**



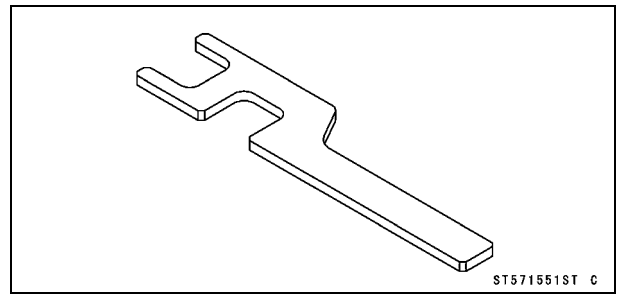

**Piston Ring Compressor Belt, $\phi$80 ~ $\phi$91:**
**57001-1320**



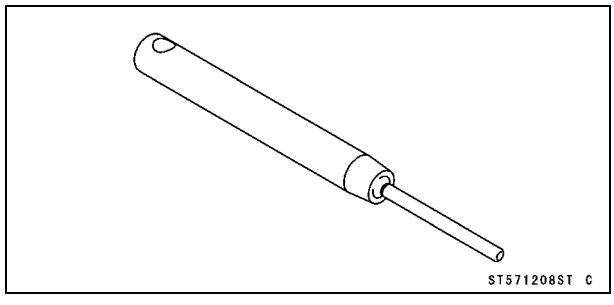

**Valve Guide Reamer, $\phi$5:**
**57001-1204**



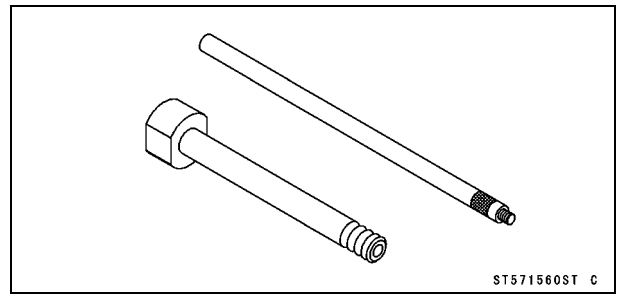

**Shaft Wrench:**
**57001-1551**




**Valve Seat Cutter Holder, $\phi$5:**
**57001-1208**

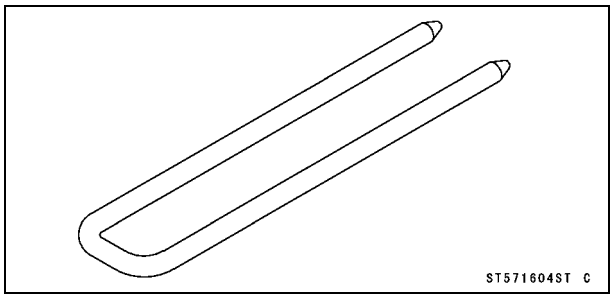



**TDC Measurement Tool:**
**57001-1560**

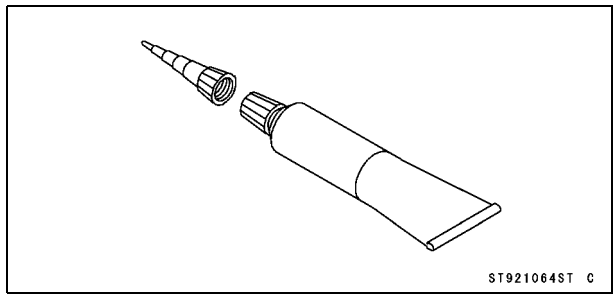


## Special Tools and Sealant

**Piston Base, $\phi$8:**
**57001-1604**



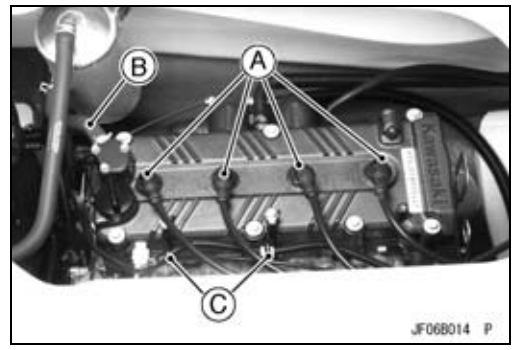

**Liquid Gasket, TB1216B:**
**92104-1064**



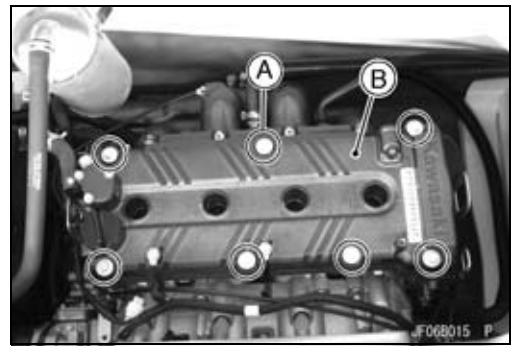
## Cylinder Head Cover

### *Cylinder Head Cover Removal*

- Remove:
  Seats (see Seat Removal in the Hull/Engine Hood chapter)
  Spark Plug Caps [A]
  Clamp and Breather Hose [B]
- Open the clamps [C].

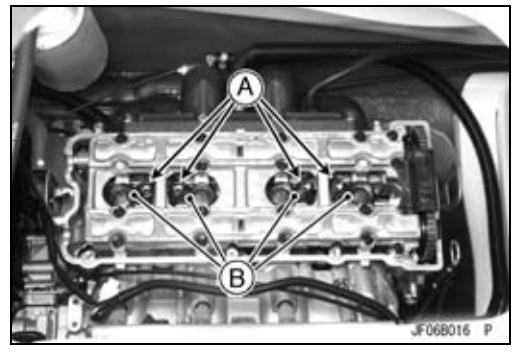



- Remove:
  Cylinder Head Cover Bolts [A] with Rubber Washers
  Cylinder Head Cover [B]



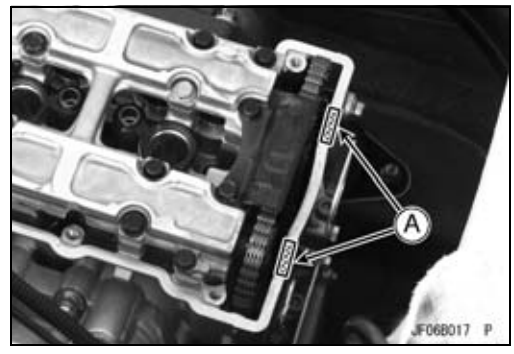

### *Cylinder Head Cover Installation*

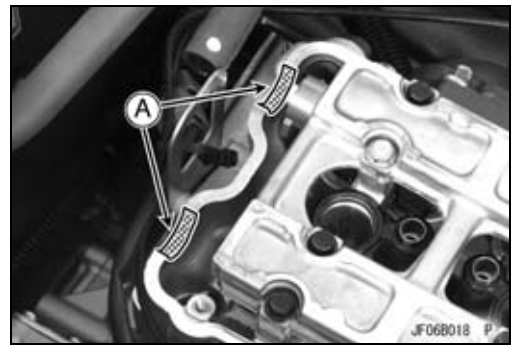
- Be sure to install the following parts.
  Dowel Pins [A]
  Plug Hole Gaskets [B]




- Using a high flash-point solvent, clean off any oil or dirt that may be on the liquid gasket coating area. Dry them with a clean cloth.
- Apply liquid gasket [A] to the cylinder head as shown in the figure.

  **Sealant - Liquid Gasket, TB1216B: 92104-1064**



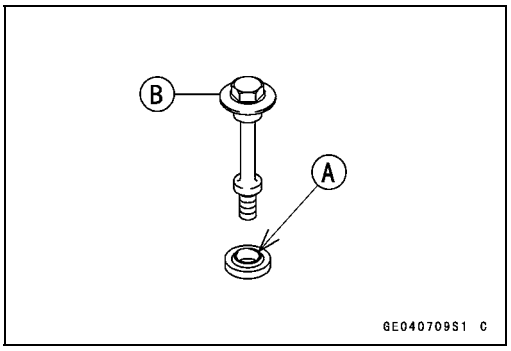



## Cylinder Head Cover

- Replace the cylinder head cover gasket with a new one.
- Install the new cylinder head cover gasket and cylinder head cover.
- Install the rubber washers with the metal side [A] faces upward.
- Tighten:

**Torque - Cylinder Head Cover Bolts [B]: 10 N·m (1.0 kgf·m, 89 in·lb)**

- Run the hose and harness correctly (see Cable, Wire and Hose Routing section in the Appendix chapter).



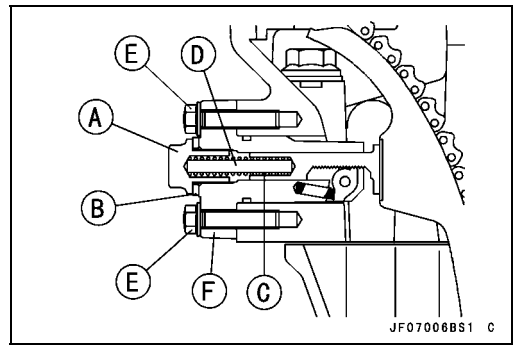
## Camshaft Chain Tensioner

### *Camshaft Chain Tensioner Removal*

**NOTICE**

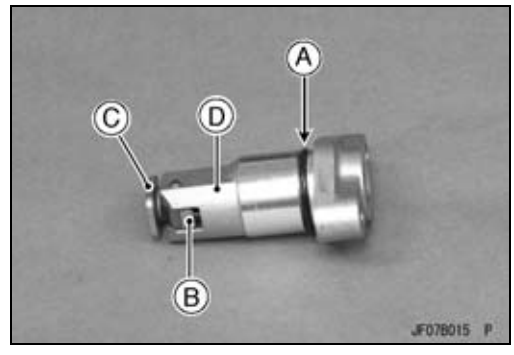
**This is a non-return type camshaft chain tensioner. The push rod does not return to its original position once it moves out to take up camshaft chain slack. Observe all the rules listed below.**
**The camshaft chain tensioner can be damaged if not removed and reset, causing severe engine damage. To prevent damaging the cam chain tensioner, do not loosen the mounting bolts only halfway. Retightening the mounting bolts from this position could damage the tensioner and the camshaft chain. Once the bolts are loosened, the tensioner must be removed and reset as described in "Camshaft Chain Tensioner Installation".**
**Turning the crankshaft while the cam chain tensioner is removed can upset the timing and damage the valves. Do not turn the crankshaft when the tensioner is removed.**

- Remove:
  Seats (see Seat Removal in the Hull/Engine Hood chapter)
  Cap Bolt [A]
  Washer [B]
  Spring [C]
  Rod [D]
  Mounting Bolts [E]
  Camshaft Chain Tensioner Body [F]




### *Camshaft Chain Tensioner Installation*

- Replace the O-ring [A] with a new one.
- Apply grease to the new O-ring.
- Release the stopper [B] and push the push rod [C] into the tensioner body [D].
- Install the tensioner body so that the stopper faces downward.

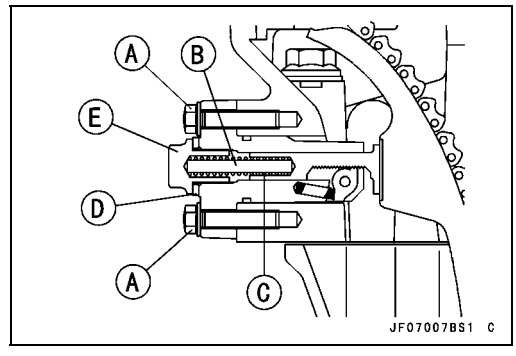



- Apply a non-permanent locking agent to the threads of the tensioner mounting bolts [A], and tighten them.

  **Torque - Camshaft Chain Tensioner Mounting Bolts: 10 N·m (1.0 kgf·m, 89 in·lb)**

- Install:
  Rod [B]
  Spring [C]
  Washer [D]
- Tighten the cap bolt [E].

  **Torque - Camshaft Chain Tensioner Cap Bolt: 20 N·m (2.0 kgf·m, 15 ft·lb)**



## Camshaft, Camshaft Chain

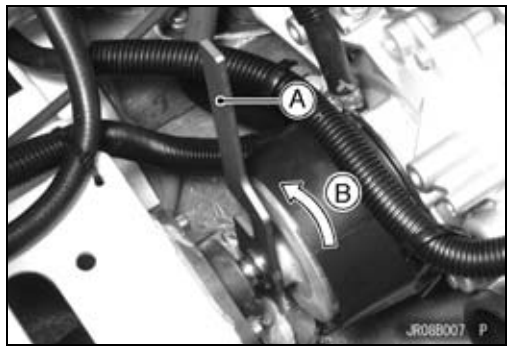
### *Camshaft Removal*

● Remove:
Seats (see Seat Removal in the Hull/Engine Hood chapter)
Handrail Plate (see Handrail Plate Removal in the Hull/Engine Hood chapter)
Spark Plugs (see Spark Plug Inspection in the Periodic Maintenance chapter)
Cylinder Head Cover (see Cylinder Head Cover Removal)

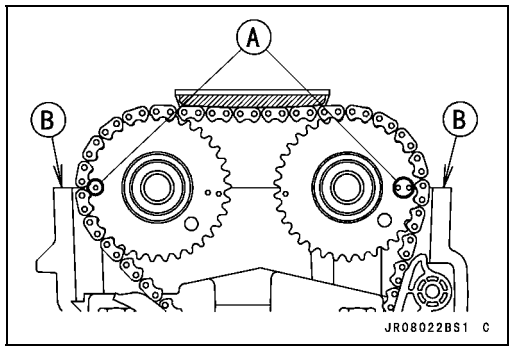
● Position the crankshaft at #1, #4 piston TDC as follows.

○Using the shaft wrench [A], turn the crankshaft counterclockwise [B] and set the crankshaft at #1, #4 piston TDC.

**Special Tool - Shaft Wrench: 57001-1551**

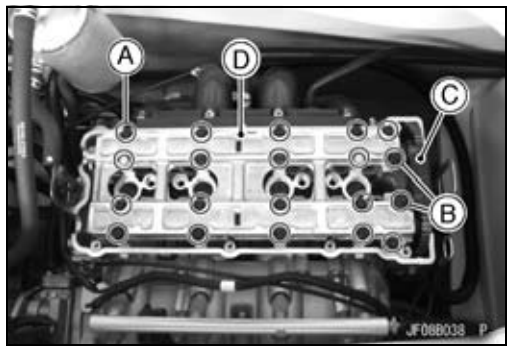



○The timing marks [A] must be aligned with the cylinder head upper surface [B] as shown in the figure.




● Remove:
Camshaft Chain Tensioner (see Camshaft Chain Tensioner Removal)
Camshaft Cap Bolts [A] and Upper Camshaft Chain Guide Bolts [B]
Upper Camshaft Chain Guide [C]
Camshaft Cap [D]
Camshafts

● Stuff a clean cloth into the chain tunnel to keep any parts from dropping into the crankcase.



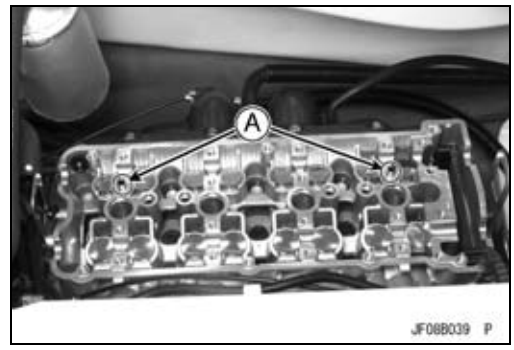

***NOTICE***

**A kinked cam chain could damage both the chain and the sprocket on the crankshaft. The crankshaft can be turned while the camshafts are removed, but always pull the cam chain taut to avoid kinking the chain on the crankshaft sprocket.**

## Camshaft, Camshaft Chain

### *Camshaft Installation*

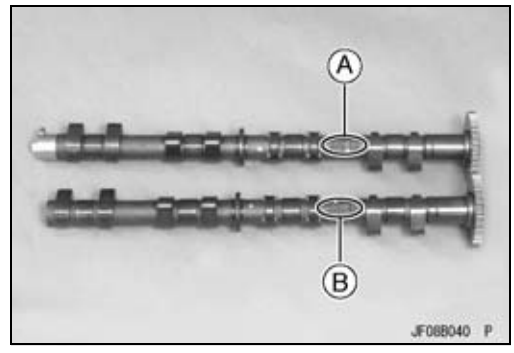
● Be sure to install the following parts.
Dowel Pins [A]




● Apply molybdenum disulfide oil solution to all cam parts, journals and tappets.

**NOTE**

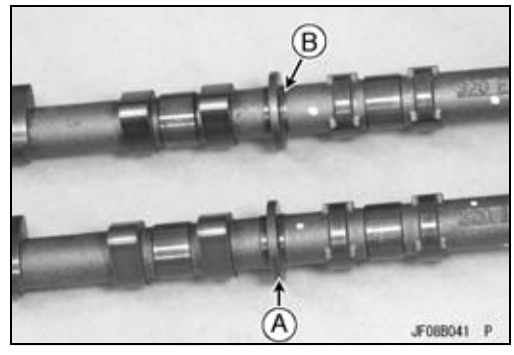
○*The exhaust camshaft has a 320 EX mark [A] and the intake camshaft has a 320 IN mark [B]. Be careful not to mix up these shafts.*



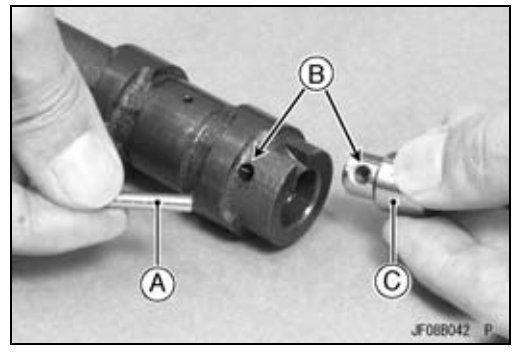

**NOTE**

○*Also the intake and exhaust camshafts have the groove identification.*

Groove [A] of Intake Camshaft
Groove [B] of Exhaust Camshaft

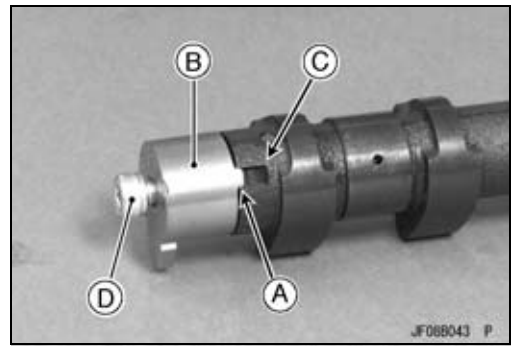



★If the camshaft position sensor rotor is removed, install it as follows.
○Insert the pin [A] into the holes [B] in the camshaft and boss [C].




○Fit the projection [A] of the rotor [B] on the camshaft recess [C].
○Apply a non-permanent locking agent (high strength: Loctite 271 equivalent) to the threads of the camshaft position sensor rotor bolt [D], and tighten it.

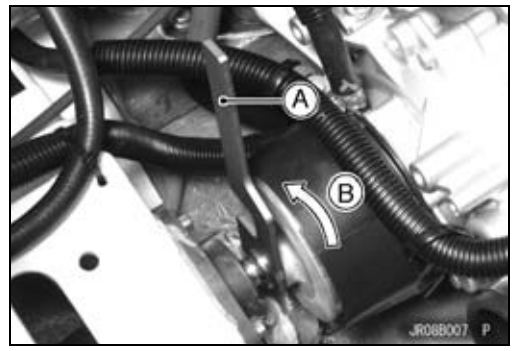
**Torque - Camshaft Position Sensor Rotor Bolt: 12 N·m (1.2 kgf·m, 106 in·lb)**



## Camshaft, Camshaft Chain

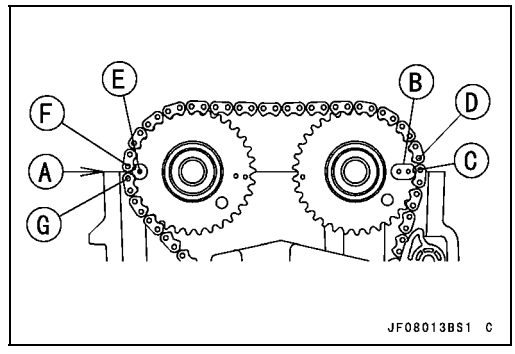
- Using the shaft wrench [A], turn the crankshaft counterclockwise [B] and set the crankshaft at #1, #4 piston TDC (see Piston TDC Finding).

**Special Tool - Shaft Wrench: 57001-1551**




- Pull the tension side (exhaust side) of the chain taut to install the chain.
- Engage the camshaft chain with the camshaft sprockets so that the timing marks on the sprockets are positioned as shown in the figure.

○The timing marks must be aligned with the cylinder head upper surface [A].
EX Mark [B]
#1 Pin [C]
#2 Pin [D]
IN Mark [E]
#31 Pin [F]
#32 Pin [G]



## Camshaft, Camshaft Chain

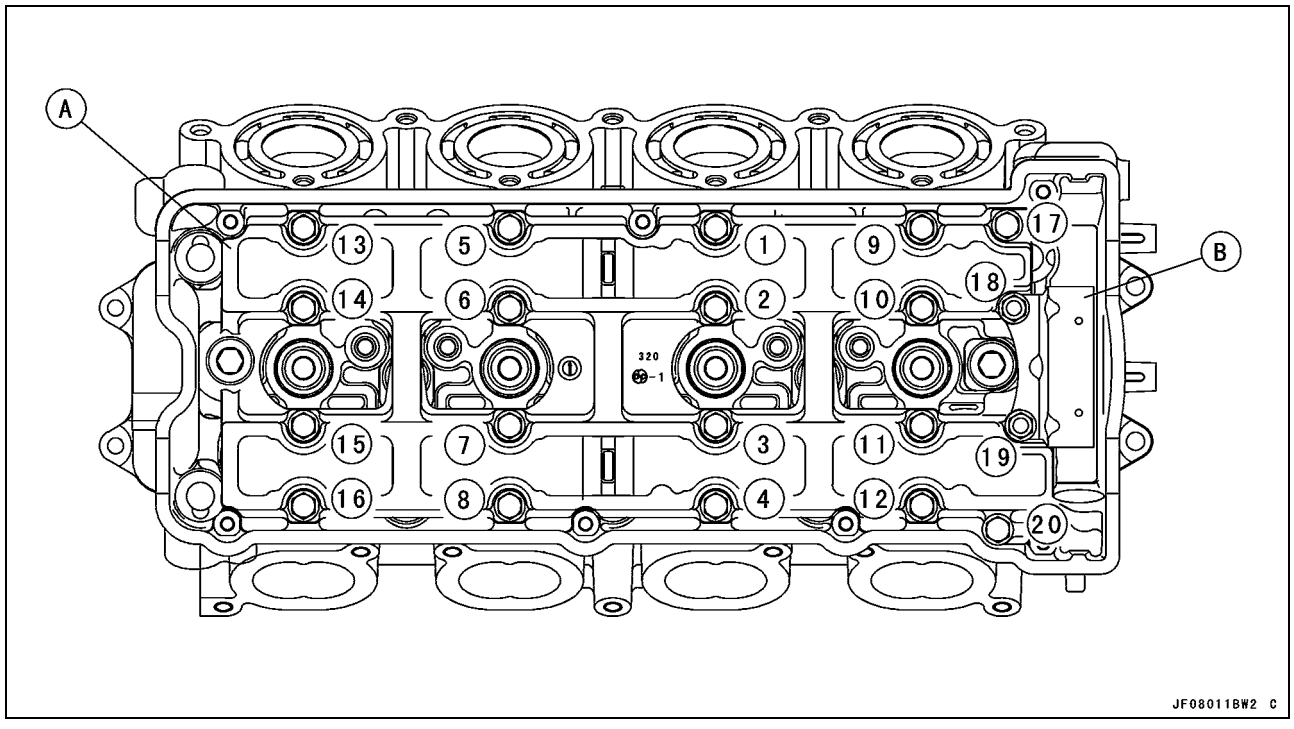
- Install the camshaft cap [A] and upper camshaft chain guide [B]. While pushing the camshaft chain, tighten all camshaft bolts and chain guide bolts.

○Install the longer (white) bolts to the #10 and #14 position shown by triangle marks.

○First tighten the all camshaft cap and chain guide bolts evenly to seat the camshaft in place, then tighten all bolts following the specified tightening sequence [1 ~ 20].

**Torque - Camshaft Cap Bolts: 12 N·m (1.2 kgf·m, 106 in·lb)**
**Upper Camshaft Chain Guide Bolts: 12 N·m (1.2 kgf·m, 106 in·lb)**

- Install the camshaft chain tensioner (see Camshaft Chain Tensioner Installation).
- Turn the crankshaft 2 turns counterclockwise to allow the tensioner to expand and recheck the camshaft chain timing.
- Install the cylinder head cover (see Cylinder Head Cover Installation).




### *Piston TDC Finding*

This job can be done when the engine is on the hull and during camshaft installation.

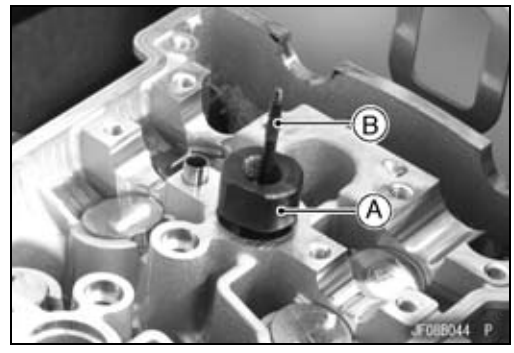
- Install the piston top detector [A] in the hole of the #1 spark plug.

**Special Tool - TDC Measurement Tool: 57001-1560**

- Insert the gauge extender [B] into the detector.
- Viewing from the bow, turn the crankshaft clockwise by using the shaft wrench until the gauge extender reaches its highest point.

**Special Tool - Shaft Wrench: 57001-1551**

- Remove the extender and install it to the gauge.



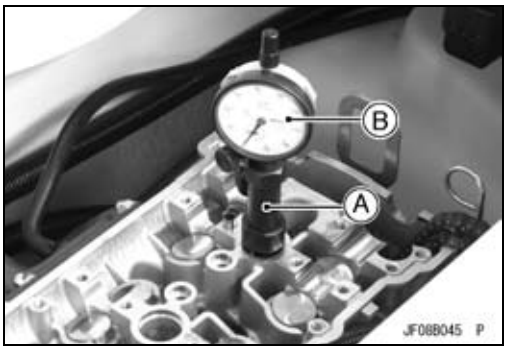
## Camshaft, Camshaft Chain

- Install the top dead center finder [A] and the gauge [B] with the extender.

**Special Tool - Top Dead Center Finder: 57001-402**

- Set the gauge to the “0”.
- Viewing from the bow, turn the crankshaft clockwise by using the shaft wrench, and read a maximum scale value of the dial gauge.

**Special Tool - Shaft Wrench: 57001-1551**

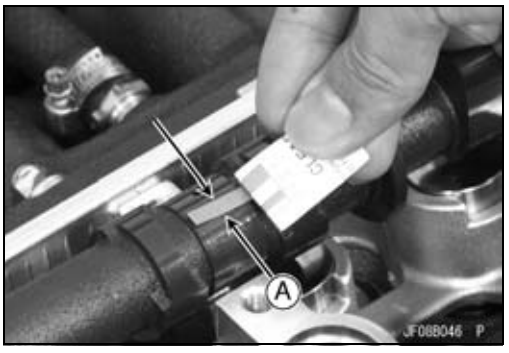



**NOTE**

○*The scale value of the dial gauge reaches a maximum at the TDC.*

### *Camshaft, Camshaft Cap Wear Inspection*

- Remove the camshaft cap (see Camshaft Removal).
- Cut strips of plastigage (press gauge) to journal width. Place a strip on each journal parallel to the camshaft installed in the correct position.
- Tighten the camshaft cap bolts and upper camshaft chain guide bolts to the specified torque (see Camshaft Installation).




**NOTE**

○*Do not turn the camshaft when the plastigage is between the journal and camshaft cap.*

- Remove the camshaft cap again, measure each clearance between the camshaft journal and the camshaft cap using plastigage [A].

**Camshaft Journal, Camshaft Cap Clearance**
**Standard: 0.028 ~ 0.071 mm (0.0011 ~ 0.0028 in.)**
**Service Limit: 0.16 mm (0.0063 in.)**

★If any clearance exceeds the service limit, measure the diameter of each camshaft journal with a micrometer.

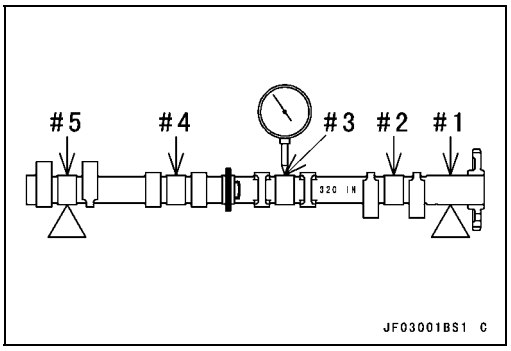
**Camshaft Journal Diameter**
**Standard: 23.950 ~ 23.972 mm (0.9429 ~ 0.9438 in.)**
**Service Limit: 23.92 mm (0.942 in.)**

★If the camshaft journal diameter is less than the service limit, replace the camshaft with a new one and measure the clearance again.
★If the clearance still remains out of the limit, replace the cylinder head unit.

### *Camshaft Runout Inspection*

- Remove the camshaft (see Camshaft Removal).
- Set the camshaft in a camshaft alignment jig or on V blocks.
- Measure runout with a dial gauge at the specified place as shown.

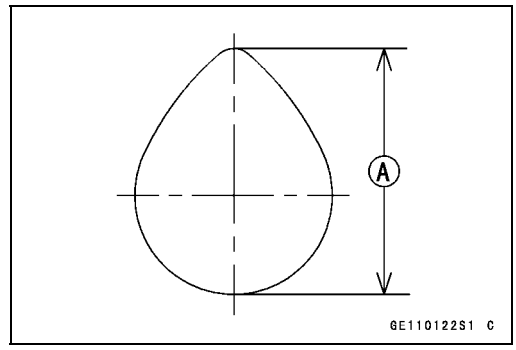
★If the runout exceeds the service limit, replace the camshaft.




**Camshaft Runout**
**Standard: TIR 0.02 mm (0.0008 in.) or less**
**Service Limit: TIR 0.1 mm (0.004 in.)**

## Camshaft, Camshaft Chain

### *Cam Wear Inspection*




- Remove the camshaft (see Camshaft Removal).
- Measure the height [A] of each cam with a micrometer.

★If the cams are worn down past the service limit, replace the camshaft.

**Cam Height**

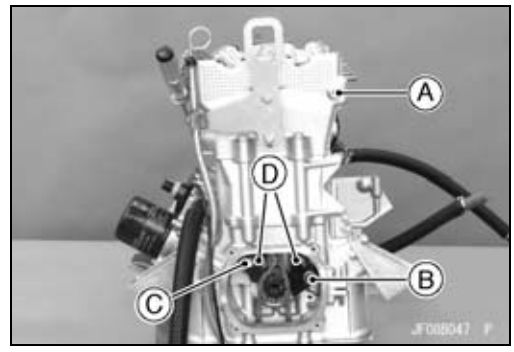
**Standard:**

| | |
|---|---|
| **Exhaust** | **36.143 ~ 36.257 mm (1.4229 ~ 1.4274 in.)** |
| **Intake** | **36.443 ~ 36.557 mm (1.4348 ~ 1.4392 in.)** |

**Service Limit:**

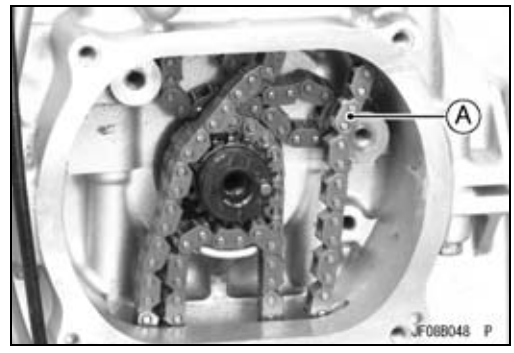
| | |
|---|---|
| **Exhaust** | **36.04 mm (1.419 in.)** |
| **Intake** | **36.34 mm (1.431 in.)** |

### *Camshaft Chain Removal*




- Remove:

  Camshafts (see Camshaft Removal)
  Timing Rotor (see Timing Rotor Removal in the Electrical System chapter)
  Exhaust Side Camshaft Chain Guide Bolt (Upper) [A]
  Exhaust Side Camshaft Chain Guide Bolt (Lower) [B]
  Intake Side Camshaft Chain Guide Bolt [C]
  Camshaft Chain Guides [D]




- Remove the camshaft chain [A] from the crankshaft sprocket.

## Cylinder Head

### *Cylinder Compression Measurement*

**NOTE**

○*Use the battery which is fully charged.*

- Thoroughly warm up the engine, while checking that there is no compression leakage from around the spark plugs or the cylinder head gasket.

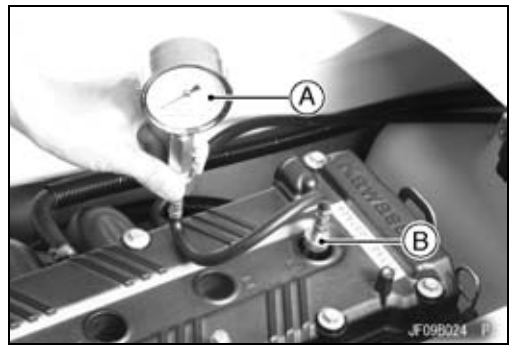
***NOTICE***

**Operating the engine without cooling water for more than 15 seconds, especially at high rpm, will cause severe engine and exhaust system damage. To avoid engine damage, do not run the engine without providing sufficient cooling water.**

- Stop the engine.
- Disconnect the ignition coil primary lead connectors (see Ignition Coil Removal in the Electrical System chapter).
- Remove:
  Spark Plugs (see Spark Plug Inspection in the Periodic Maintenance chapter)

- Attach the compression gauge [A] and adapter [B] firmly into the spark plug hole.
- Using the starter motor, turn the engine over with the throttle fully open until the compression gauge stops rising; the compression is the highest reading obtainable.

**Special Tools - Compression Gauge, 20 kgf/cm²: 57001-221**
**Compression Gauge Adapter, M10 × 1.0: 57001-1317**



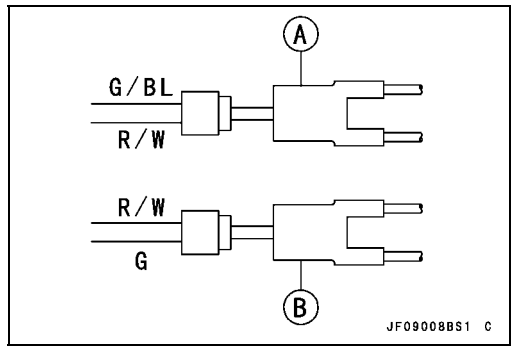

**Cylinder Compression**
**Usable Range: 1 190 ~ 1 795 kPa (12.1 ~ 18.3 kgf/cm², 173 ~ 260 psi) at 430 r/min (rpm)**

- Repeat the measurement for the other cylinders.
- Install the spark plugs (see Spark Plug Inspection in the Periodic Maintenance chapter).

- Reconnect the ignition coil primary lead connectors, noting the #1, #4 [A] and the #2, #3 [B] coil connectors. the #1, #4 coil connector has a red/white and a green/blue leads from the main harness. The #2, #3 coil connector has a red/white and green leads from the main harness.

**NOTE**

○*The service codes (51 and 52) caused by this procedure are stored in the ECU.*



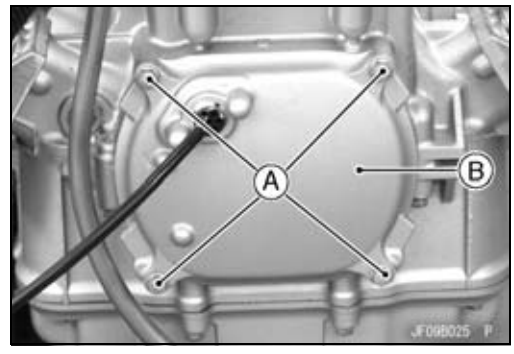
## Cylinder Head

The following table should be consulted if the obtainable compression reading is not within the usable range.

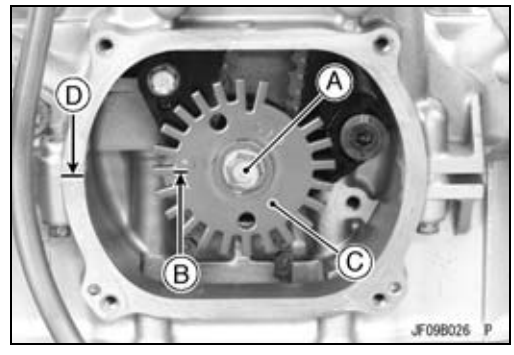
| Problem | Diagnosis | Remedy (Action) |
|---|---|---|
| Cylinder compression is higher than usable range. | Carbon accumulation on piston and in combustion chamber possibly due to damaged valve stem oil seal and/or damaged piston oil rings (This may be indicated by white exhaust smoke). | Remove the carbon deposits and replace damaged parts if necessary. |
| | Incorrect cylinder head gasket thickness | Replace the gasket with a standard part. |
| Cylinder compression is lower than usable range. | Gas leakage around cylinder head | Replace damaged gasket and check cylinder head warp. |
| | Bad condition of valve seating | Repair if necessary. |
| | Incorrect valve clearance | Adjust the valve clearance. |
| | Incorrect piston/cylinder clearance | Replace the piston and/or cylinder. |
| | Piston seizure | Inspect the cylinder and replace/repair the cylinder and/or piston as necessary. |
| | Bad condition of piston ring and/or piston ring grooves | Replace the piston and/or the piston rings. |

### *Cylinder Head Removal*

- Drain the engine oil (see Engine Oil Change in the Periodic Maintenance chapter).
- Remove:
  Engine (see Engine Removal in the Engine Removal/Installation chapter)
  Cylinder Head Cover (see Cylinder Head Cover Removal)
  Crankshaft Sensor Cover Bolts [A]
  Crankshaft Sensor Cover [B]

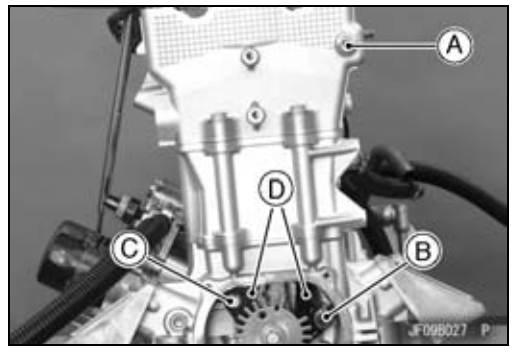



- Using a wrench on the timing rotor bolt [A], turn the crankshaft clockwise until the line [B] (TDC mark for #1, #4 position) on the timing rotor [C] is aligned with the mating surface [D] of the crankcase.
- Remove:
  Camshaft Chain Tensioner (see Camshaft Chain Tensioner Removal)
  Camshafts (see Camshaft Removal)
  Dipstick Tube (see Oil Pan Removal in the Engine Lubrication System chapter)

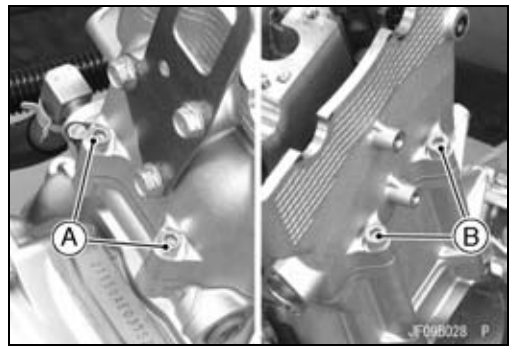


## Cylinder Head

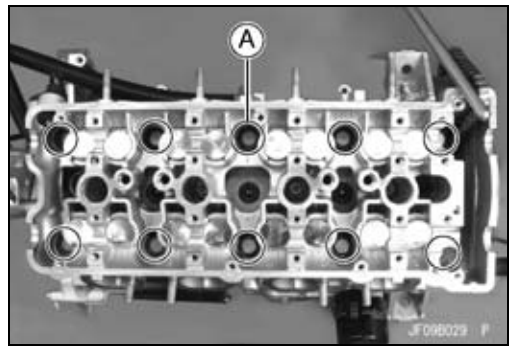
● Remove:
Exhaust Side Camshaft Chain Guide Bolt (Upper) [A]
Exhaust Side Camshaft Chain Guide Bolt (Lower) [B]
Intake Side Camshaft Chain Guide Bolt [C]
Camshaft Chain Guides [D]




● Remove:
M6 Cylinder Head Bolts [A]
M7 Cylinder Head Bolts [B]




● Remove the M11 cylinder head bolts [A] and washers.
● Remove:
Cylinder Head
Oil Pipe

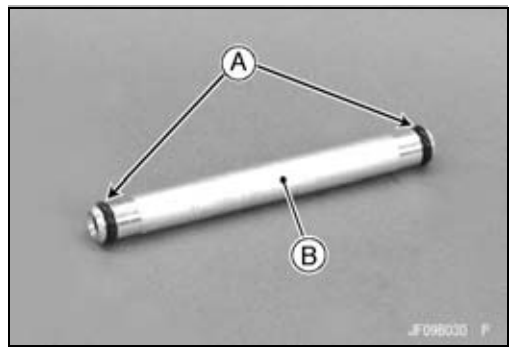



### *Cylinder Head Installation*

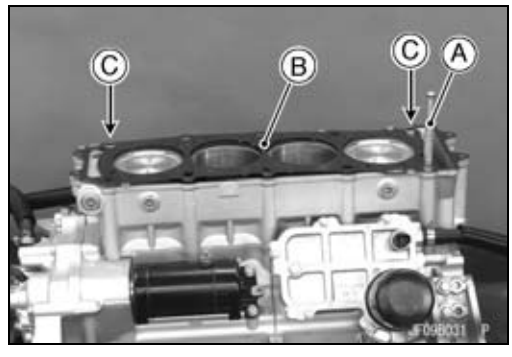
**NOTE**

○*The camshaft cap is machined with the cylinder head, so if a new cylinder head is installed, use the cap that is supplied with the new head.*

● Replace the O-rings [A] of the oil pipe [B] with new ones.
● Apply molybdenum disulfide oil solution to O-rings.

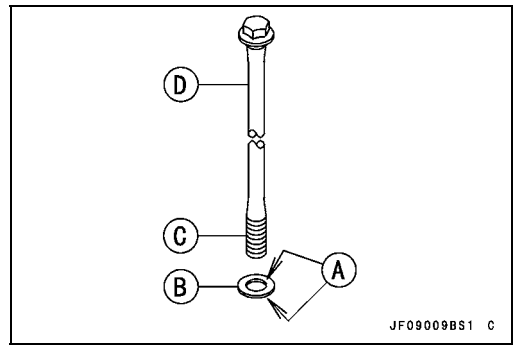



● Install that the oil pipe [A].
● Install a new cylinder head gasket [B], and dowel pins [C].



## Cylinder Head

- Apply molybdenum disulfide oil solution to both sides [A] of the cylinder head bolt washers [B] and the thread [C] of head bolts [D].




- Install the cylinder head.
- Tighten the M11 cylinder head bolts following the tightening sequence [1 ~ 10].

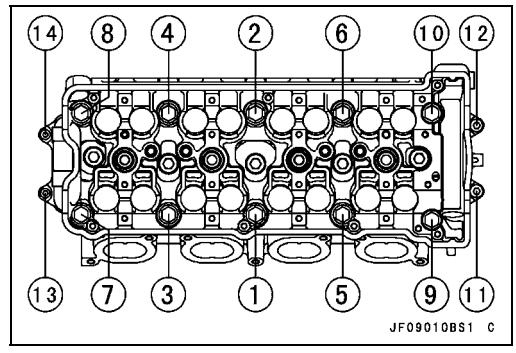
**Torque - Cylinder Head Bolts (M11):**
**First: 23 N·m (2.3 kgf·m, 17 ft·lb)**
**Final: 60 N·m (6.1 kgf·m, 44 ft·lb)**

- Tighten the M7 cylinder head bolts following the tightening sequence [11, 12].

**Torque - Cylinder Head Bolts (M7): 20 N·m (2.0 kgf·m, 15 ft·lb)**

- Tighten the M6 cylinder head bolts following the tightening sequence [13, 14].

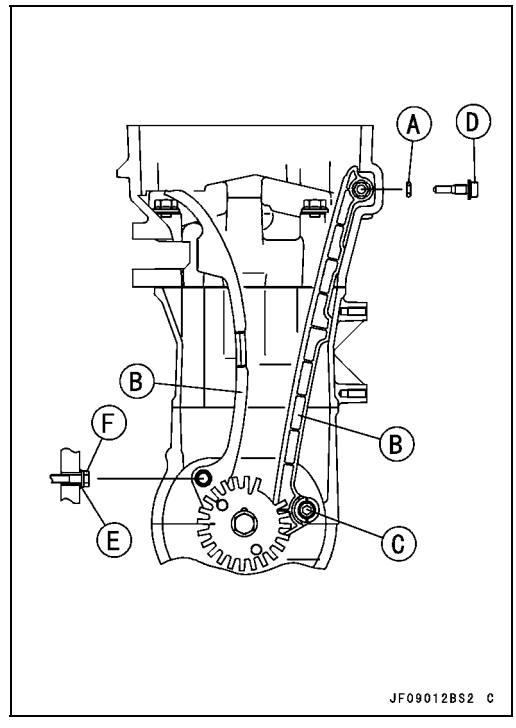
**Torque - Cylinder Head Bolts (M6): 12 N·m (1.2 kgf·m, 106 in·lb)**




- Replace the O-ring [A] with a new one.
- Install:
  Camshaft Chain Guides [B]
  New O-ring
  Exhaust Side Camshaft Chain Guide Bolt (Lower) [C]
  Exhaust Side Camshaft Chain Guide Bolt (Upper) [D]
  Collar [E]
- Apply a non-permanent locking agent to the intake side camshaft chain guide bolt [F] and install it.
- Tighten:

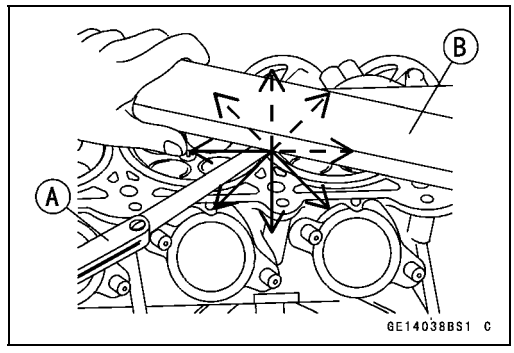
**Torque - Exhaust Side Camshaft Chain Guide Bolt (Lower): 12 N·m (1.2 kgf·m, 106 in·lb)**
**Exhaust Side Camshaft Chain Guide Bolt (Upper): 25 N·m (2.5 kgf·m, 18 ft·lb)**
**Intake Side Camshaft Chain Guide Bolt: 12 N·m (1.2 kgf·m, 106 in·lb)**

- Install the removed parts (see appropriate chapters).



## Cylinder Head

### *Cylinder Head Warp Inspection*




- Remove the cylinder head (see Cylinder Head Removal).
- Clean the cylinder head.
- Lay a straightedge across the lower surface of the cylinder head at several positions.
- Use a thickness gauge [A] to measure the space between the straightedge [B] and the head.

**Cylinder Head Warp**
**Standard: – – –**
**Service Limit: 0.05 mm (0.0020 in.)**

★If the cylinder head is warped more than the service limit, replace it.

★If the cylinder head is warped less than the service limit, repair the head by rubbing the lower surface on emery paper secured to a surface plate (first No. 200, then No. 400).

## Valves

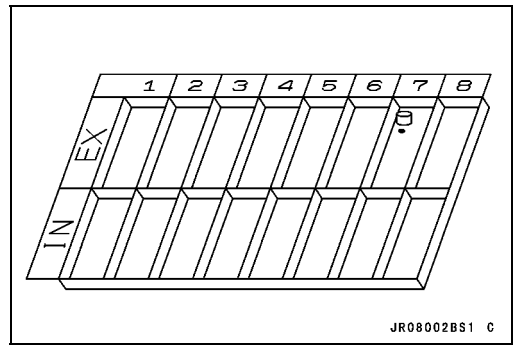
### *Valve Clearance Inspection*

- Refer to the Valve Clearance Inspection in the Periodic Maintenance chapter.

### *Valve Removal*

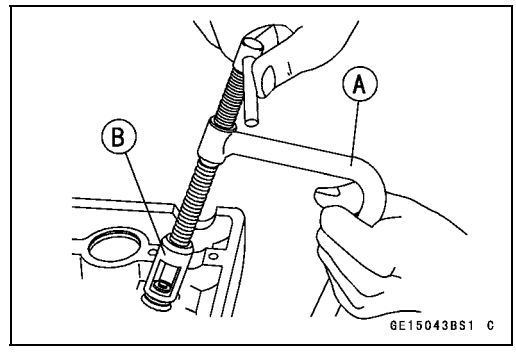
- Remove the cylinder head (see Cylinder Head Removal).
- Remove the valve lifter and shim.

○Mark and record the valve lifter and shim locations so they can be installed in their original positions.




- Using the valve spring compressor assembly, remove the valve.

**Special Tools - Valve Spring Compressor Assembly [A]: 57001-241**
**Valve Spring Compressor Adapter, $\phi$22 [B]: 57001-1202**

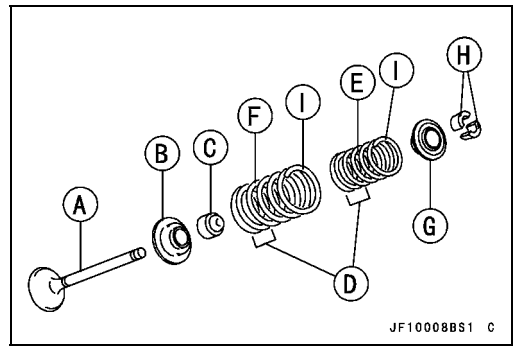



### *Valve Installation*

- Replace the oil seal with a new one.
- Apply a thin coat of molybdenum disulfide grease to the valve stem before valve installation.
- Install the springs so that the closed coil end faces downwards.

○Painted side faces upward.

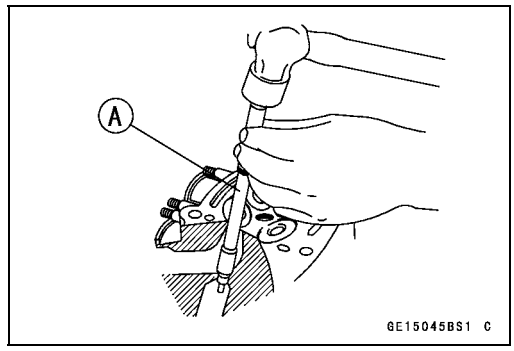
Valve Spring Paint Color: EX - Red
IN - Blue




Valve Stem [A]
Spring Seat [B]
Oil Seal [C]
Closed Coil End [D]
Valve Spring (Inner) [E]
Valve Spring (Outer) [F]
Retainer [G]
Split Keepers [H]
Paint Mark [I]

## Valves

### *Valve Guide Removal*



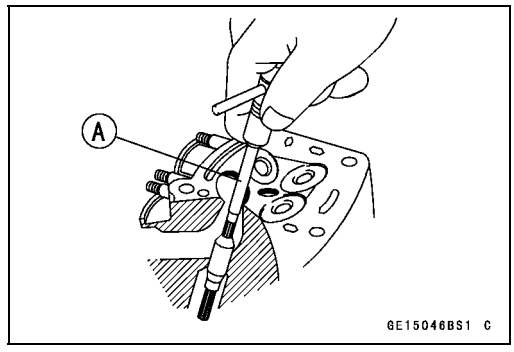

- Remove:
  Valve (see Valve Removal)
  Oil Seal
  Spring Seat
- Heat the area around the valve guide to 120 ~ 150°C (248 ~ 302°F), and hammer lightly on the valve guide arbor [A] to remove the guide from the top of the head.

**NOTICE**

**Heating the cylinder head with a torch will warp the head. To prevent warping the cylinder head, soak it in hot oil.**

**Special Tool - Valve Guide Arbor, $\phi$5: 57001-1203**

### *Valve Guide Installation*




- Apply engine oil to the valve guide outer surface before installation.
- Heat the area around the valve guide hole to about 120 ~ 150°C (248 ~ 302°F).

**NOTICE**

**Heating the cylinder head with a torch will warp the head. To prevent warping the cylinder head, soak it in hot oil.**

- Drive the valve guide in from the top of the head using the valve guide arbor. The flange stops the guide from going in too far.

**Special Tool - Valve Guide Arbor, $\phi$5: 57001-1203**

- Wait until the cylinder head cools down and then ream the valve guide with the valve guide reamer [A] even if the old guide is reused.

○Turn the reamer in a clockwise direction until the reamer turns freely in the guide. Never turn the reamer counter-clockwise or it will be dulled.

○Once the guides are reamed they must be cleaned thoroughly.

**Special Tool - Valve Guide Reamer, $\phi$5: 57001-1204**

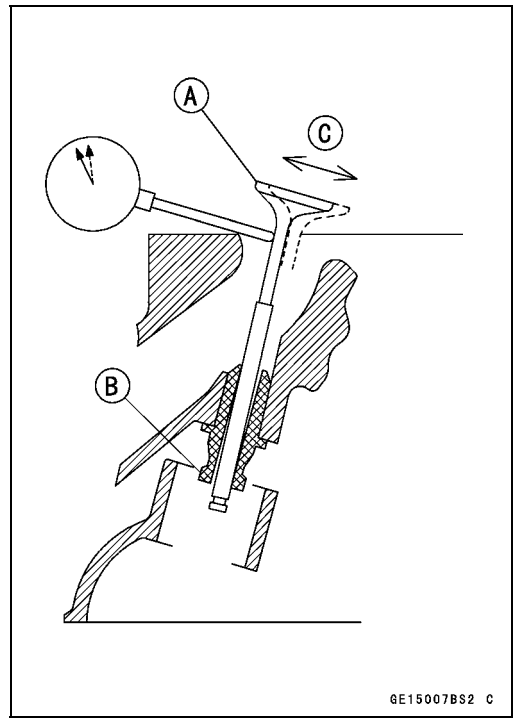
## Valves

### *Valve-to-Guide Clearance Measurement (Wobble Method)*

If a small bore gauge is not available, inspect the valve guide wear by measuring the valve to valve guide clearance with the wobble method as indicated below.

- Insert a new valve [A] into the guide [B] and set a dial gauge against the stem perpendicular to it as close as possible to the cylinder head mating surface.
- Move the stem back and forth [C] to measure valve/valve guide clearance.
- Repeat the measurement in a direction at a right angle to the first.

★If the reading exceeds the service limit, replace the guide.




**NOTE**

○*The reading is not actual valve/valve guide clearance because the measuring point is above the guide.*

**Valve/Valve Guide Clearance (Wobble Method)**

**Standard:**

| | |
|---|---|
| **Exhaust** | **0.09 ~ 0.17 mm (0.0035 ~ 0.0067 in.)** |
| **Intake** | **0.03 ~ 0.11 mm (0.0012 ~ 0.0043 in.)** |

**Service Limit:**

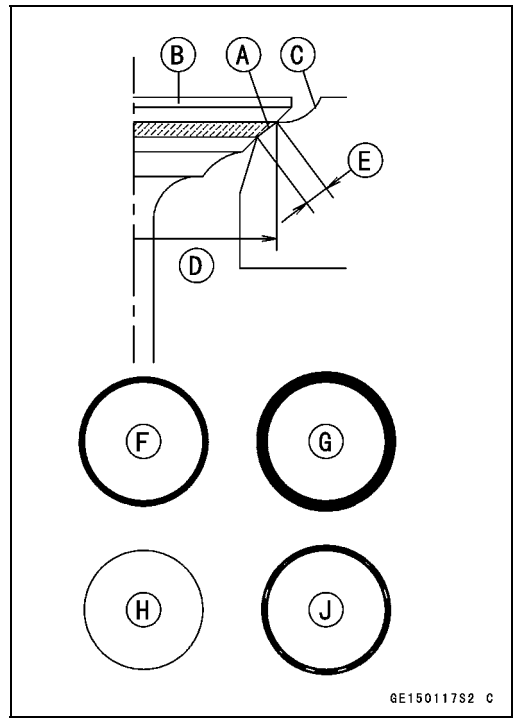
| | |
|---|---|
| **Exhaust** | **0.35 mm (0.014 in.)** |
| **Intake** | **0.29 mm (0.011 in.)** |

### *Valve Seat Inspection*

- Remove the valve (see Valve Removal).
- Check the valve seating surface [A] between the valve [B] and valve seat [C].

○Measure the outside diameter [D] of the seating pattern on the valve seat.

★If the outside diameter is too large or too small, repair the seat (see Valve Seat Repair).




**Valve Seating Surface Outside Diameter**

**Standard:**

| | |
|---|---|
| **Exhaust** | **27.6 ~ 27.8 mm (1.087 ~ 1.094 in.)** |
| **Intake** | **32.6 ~ 32.8 mm (1.283 ~ 1.291 in.)** |

○Measure the seat width [E] of the portion where there is no build-up carbon (white portion) of the valve seat with a vernier caliper.

Good [F]

★If the width is too wide [G], too narrow [H] or uneven [J], repair the seat (see Valve Seat Repair).

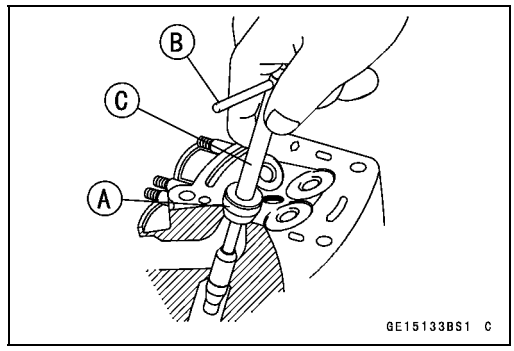
**Valve Seating Surface Width**

**Standard:**

| | |
|---|---|
| **Exhaust** | **0.8 ~ 1.2 mm (0.031 ~ 0.047 in.)** |
| **Intake** | **0.5 ~ 1.0 mm (0.020 ~ 0.039 in.)** |

## Valves

### *Valve Seat Repair*




● Repair the valve seat with the valve seat cutters [A].

**Special Tools - Valve Seat Cutter Holder Bar [B]: 57001-1128**

**Valve Seat Cutter Holder, $\phi$5 [C]: 57001-1208**

**[For Exhaust Valve Seat]**

**Valve Seat Cutter, 45° - $\phi$30: 57001-1187**

**Valve Seat Cutter, 32° - $\phi$30: 57001-1120**

**Valve Seat Cutter, 60° - $\phi$30: 57001-1123**

**[For Intake Valve Seat]**

**Valve Seat Cutter, 45° - $\phi$35: 57001-1116**

**Valve Seat Cutter, 32° - $\phi$35: 57001-1121**

**Valve Seat Cutter, 55° - $\phi$35: 57001-1247**

★If the manufacturer's instructions are not available, use the following procedure.

**Seat Cutter Operation Care**

1. This valve seat cutter is developed to grind the valve for repair. Therefore the cutter must not be used for other purposes than seat repair.
2. Do not drop or shock the valve seat cutter, or the diamond particles may fall off.
3. Do not fail to apply engine oil to the valve seat cutter before grinding the seat surface. Also wash off ground particles sticking to the cutter with washing oil.

**NOTE**

○*Do not use a wire brush to remove the metal particles from the cutter. It will take off the diamond particles.*

4. Setting the valve seat cutter holder in position, operate the cutter in one hand. Do not apply too much force to the diamond portion.

**NOTE**

○*Prior to grinding, apply engine oil to the cutter and during the operation, wash off any ground particles sticking to the cutter with washing oil.*

5. After use, wash it with washing oil and apply thin layer of engine oil before storing.

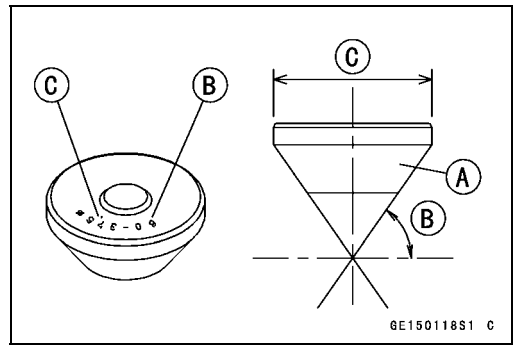
## Valves

**Marks Stamped on the Cutter**

The marks stamped on the back of the cutter [A] represent the following.

60° ..... Cutter angle [B]

37.5$\phi$ ..... Outer diameter of cutter [C]




**Operating Procedures**

- Clean the seat area carefully.
- Coat the seat with machinist's dye.
- Fit a 45° cutter into the holder and slide it into the valve guide.
- Press down lightly on the handle and turn it right or left. Grind the seating surface only until it is smooth.

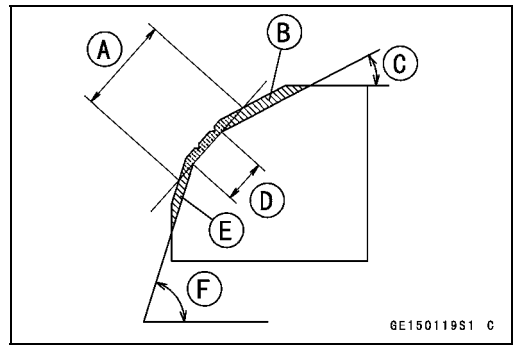
***NOTICE***

**Overgrinding the seat will reduce valve clearance by sinking the valve into the head. If the valve sinks too far into the head, it will be impossible to adjust the clearance, and the cylinder head must be replaced. Do not overgrind the seat.**

- Measure the outside diameter of the seating surface with a vernier caliper.

★If the outside diameter of the seating surface is too small, repeat the 45° grind until the diameter is within the specified range.

Widened Width [A] of engagement by machining with 45° cutter
Ground Volume [B] by 32° cutter
32° [C]
Correct Width [D]
Ground Volume [E] by 60° or 55° cutter
60° or 55° [F]




- Measure the outside diameter of the seating surface with a vernier caliper.

★If the outside diameter of the seating surface is too small, repeat the 45° grind [A] until the diameter is within the specified range.

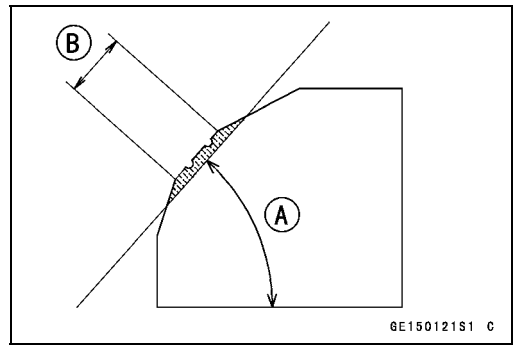
Original Seating Surface [B]

**NOTE**

○*Remove all pittings of flaws from 45° ground surface.*

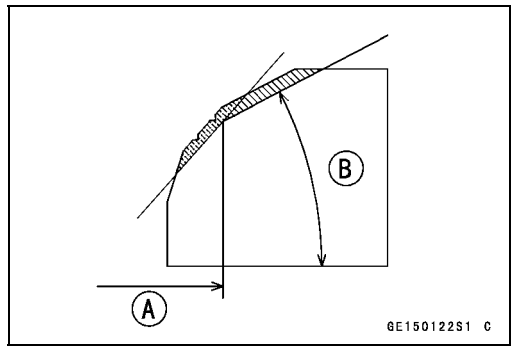
○*After grinding with 45° cutter, apply thin coat of machinist's dye to seating surface. This makes seating surface distinct and 32° and 60° grinding operation easier.*

○*When the valve guide is replaced, be sure to grind with 45° cutter for centering and good contact.*



## Valves

★If the outside diameter [A] of the seating surface is too large, make the 32° grind described below.
★If the outside diameter of the seating surface is within the specified range, measure the seat width as described below.
● Grind the seat at a 32° angle [B] until the seat outside diameter is within the specified range.
○To make the 32° grind, fit a 32° cutter into the holder, and slide it into the valve guide.
○Turn the holder one turn at a time while pressing down very lightly. Check the seat after each turn.

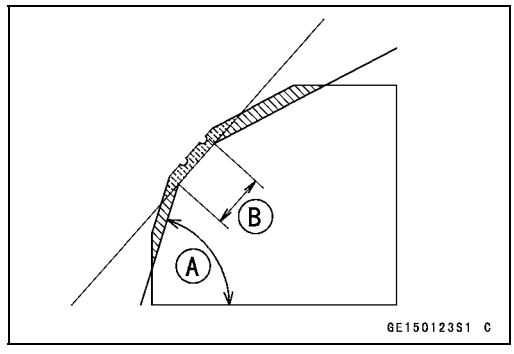



***NOTICE***

**The 32° cutter removes material very quickly. Check the seat outside diameter frequently to prevent overgrinding.**

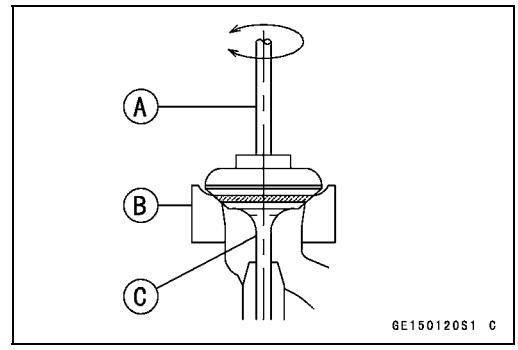
○After making the 32° grind, return to the seat outside diameter measurement step above.
● To measure the seat width, use a vernier caliper to measure the width of the 45° angle portion of the seat at several places around the seat.
★If the seat width is too narrow, repeat the 45° grind until the seat is slightly too wide, and then return to the seat outside diameter measurement step above.

★If the seat width is too wide, make the 60° or 55° [A] grind described below.
★If the seat width is within the specified range, lap the valve to the seat as described below.
● Grind the seat at a 60° or 55° angle until the seat width is within the specified range.
○To make the 60° or 55° grind, fit 60° or 55° cutter into the holder, and slide it into the valve guide.
○Turn the holder, while pressing down lightly.
○After making the 60° or 55° grind, return to the seat width measurement step above.




Correct Width [B]

## Valves




- Lap the valve to the seat, once the seat width and outside diameter are within the ranges specified above.

○Put a little coarse grinding compound on the face of the valve in a number of places around the valve head.

○Spin the valve against the seat until the grinding compound produces a smooth, matched surface on both the seat and the valve.

○Repeat the process with a fine grinding compound.

Lapper [A]
Valve Seat [B]
Valve [C]

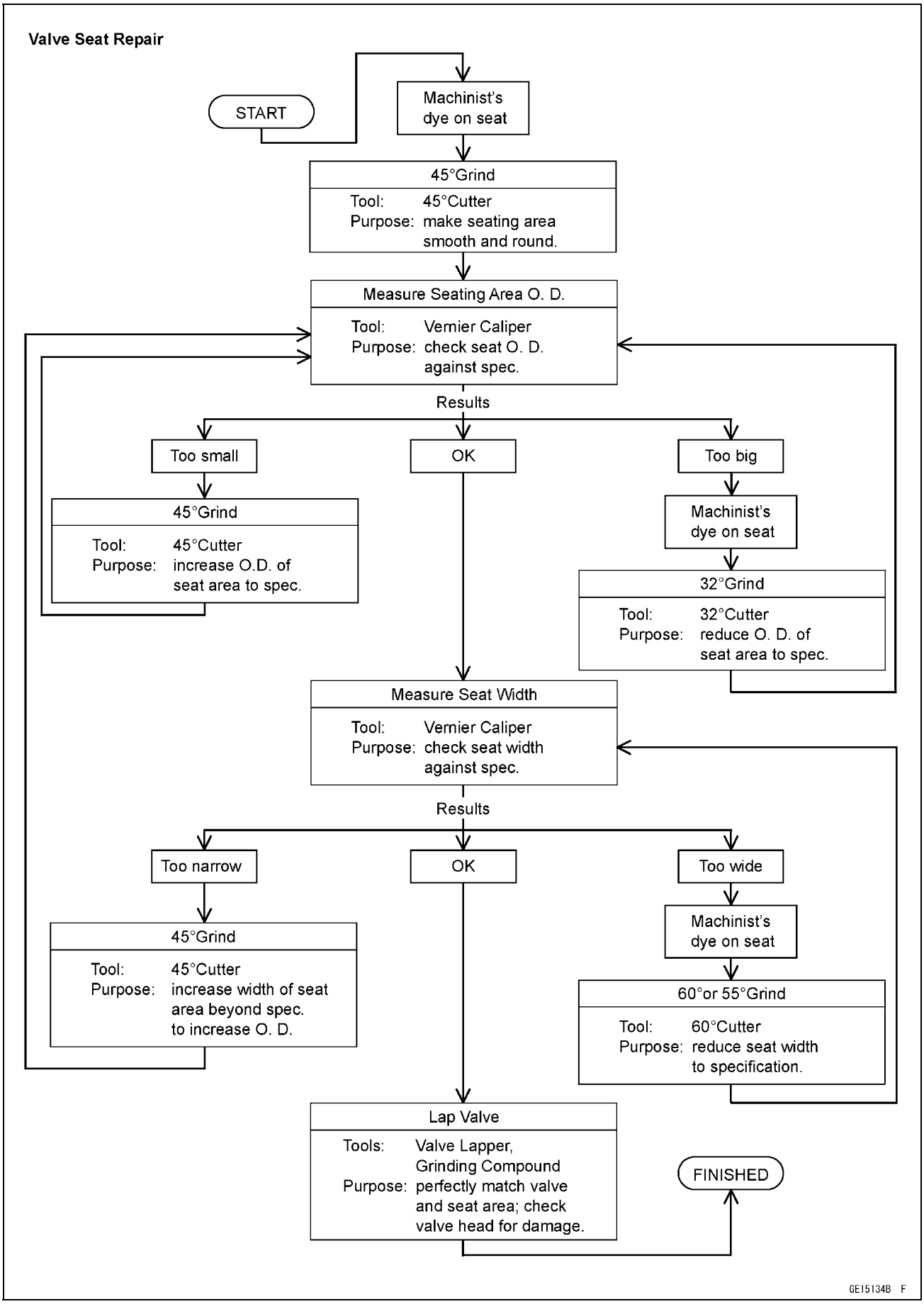
- The seating area should be marked about in the middle of the valve face.

★If the seat area is not in the right place on the valve, check to be sure the valve is the correct part. If it is, it may have been refaced too much; replace it.

- Be sure to remove all grinding compound before assembly.
- When the engine is assembled, be sure to adjust the valve clearance (see Valve Clearance Inspection in the Periodic Maintenance chapter).

## Valves

**Valve Seat Repair**

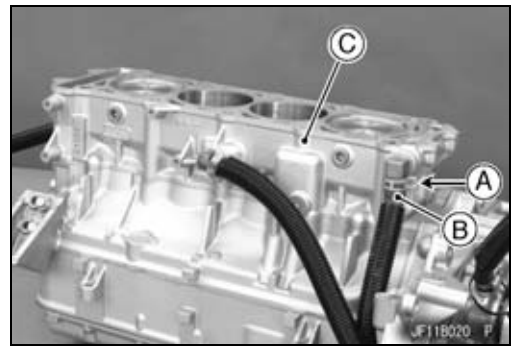


## Cylinder, Pistons

### *Cylinder Removal*

- Drain the engine oil (see Engine Oil Change in the Periodic Maintenance chapter).
- Remove:
  Engine (see Engine Removal in the Engine Removal/Installation chapter)
  Cylinder Head (see Cylinder Head Removal)

- Remove:
  Clamp [A]
  Oil Hose [B]
  Cylinder [C]

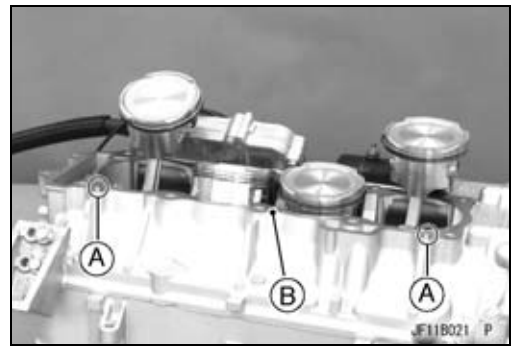



### *Cylinder Installation*

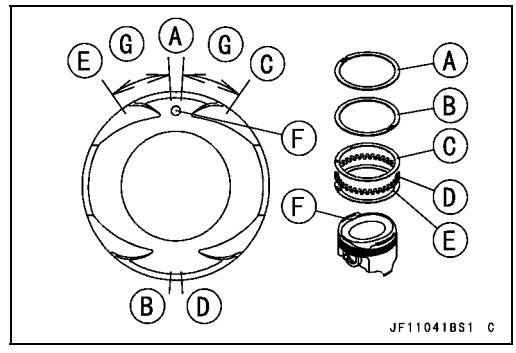
**NOTE**

○*If a new cylinder is used, use new piston ring.*

- Install the knock pins [A] and new cylinder gasket [B].




- The piston ring openings must be positioned as shown in the figure. The openings of the oil ring steel rails must be about 30 ~ 40° of angle from the opening of the top ring.
  Top Ring [A]
  Second Ring [B]
  Oil Ring Steel Rail (Upper) [C]
  Oil Ring Expander [D]
  Oil Ring Steel Rail (Lower) [E]
  Dent [F]
  30 ~ 40° [G]




- Apply molybdenum disulfide oil solution to the cylinder bore, piston rings and piston skirt.
- Insert the piston in the cylinder by either of the following two methods, “With the Hands” of “With the Special Tools”.

**With the Hand**

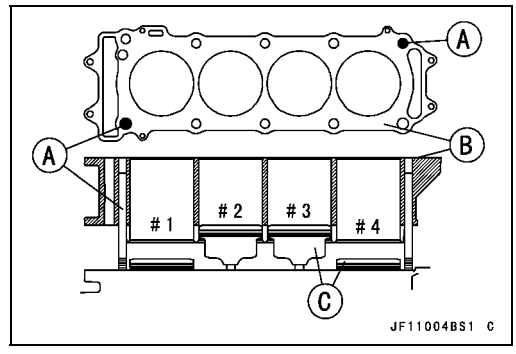
- Position the crankshaft at #2, #3 piston TDC.
- Prepare two auxiliary head bolts with their head cut.

○Install the two bolts [A] diagonally in the crankcase.

- Install the cylinder block [B].
  Pistons [C]

○First insert the #2, #3 pistons, and then rotate the crankshaft at 90° angle.

○Insert the piston rings with your thumbs or the thin (–) screwdriver.



## Cylinder, Pistons

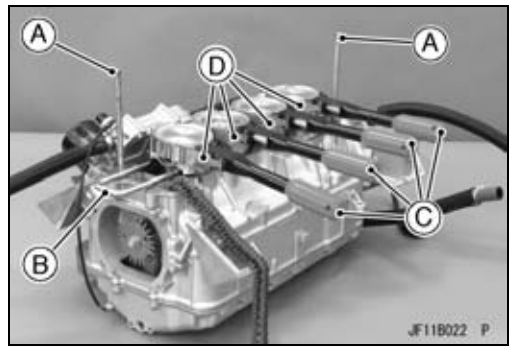
**With the Special Tools**

- Prepare two auxiliary head bolts with their head cut.

○Install the two bolts [A] diagonally in the crankcase.

- Slip the piston base [B] under the pistons to hold them level.
- Compress the piston rings using the piston ring compressor grips [C] and piston ring compressor belts [D].

**Special Tools - Piston Ring Compressor Grip: 57001-1095**
**Piston Ring Compressor Belt, $\phi$80 ~ $\phi$91: 57001-1320**
**Piston Base, $\phi$8: 57001-1604**



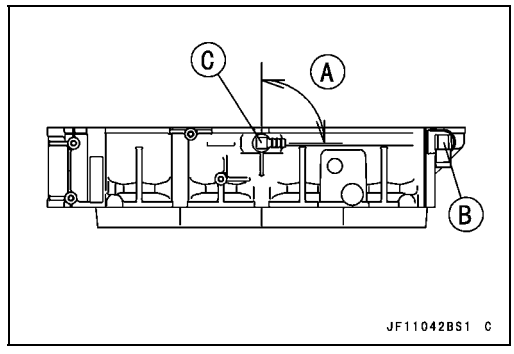

- Push down vigorously the cylinder aligning the cylinder bores with all the piston heads.
- Install the cylinder so that its angle aligns the piston angle after removing the piston ring compressor belts and piston base.
- Remove the two bolts.

- If the joints have been removed, install the joints as shown in the figure.
  90° [A]

○Apply a non-permanent locking agent to the threads of the joints, and tighten them.

**Torque - Oil Passage Joint [B]: 11 N·m (1.1 kgf·m, 97 in·lb)**
**Water Hose Joint [C]: 11 N·m (1.1 kgf·m, 97 in·lb)**

- Install the removed parts (see appropriate chapters).




### *Piston Removal*

- Remove the cylinder (see Cylinder Removal).
- Place a clean cloth under the pistons and remove the piston pin snap ring [A] from the outside of each piston.

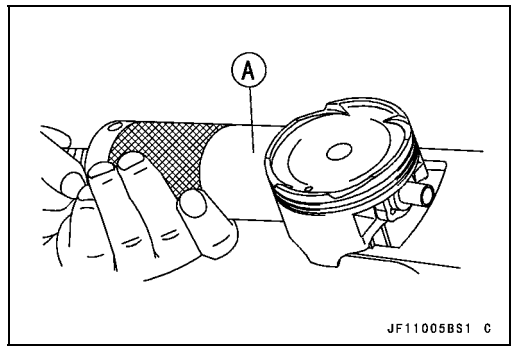
***NOTICE***

**Snap rings are weakened and deform when removed and may fall out, scoring the cylinder wall and causing severe engine damage. Do not re-use snap rings, always replace them.**

- Using the piston pin puller [A], remove the piston pins.

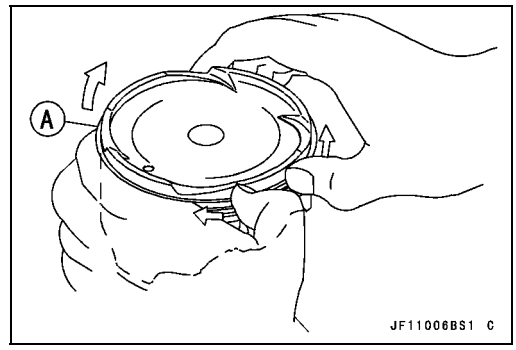
**Special Tool - Piston Pin Puller Assembly: 57001-910**

- Remove the pistons from the connecting rods.



## Cylinder, Pistons

- Carefully spread the ring opening with your thumbs and then push up on the opposite side of the ring [A] to remove it.
- Remove the 3-piece oil ring with your thumbs in the same manner.

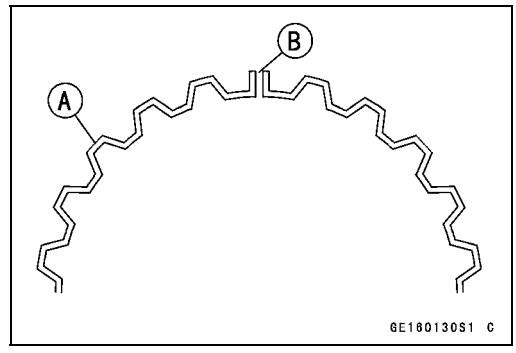



### *Piston Installation*

- Apply molybdenum disulfide oil solution to the oil ring expander, and install the oil ring expander [A] in the bottom piston ring groove so the ends [B] butt together.
- Apply molybdenum disulfide oil solution to the oil ring steel rails, and install the oil ring steel rails, one above the expander and one below it.

○Spread the rail with your thumbs, but only enough to fit the rail over the piston.

○Release the rail into the bottom piston ring groove.




**NOTE**

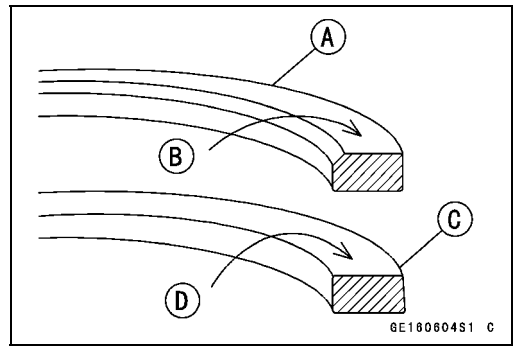
○*The oil ring rails have no "top" or "bottom".*

- Apply molybdenum disulfide oil solution to the top and second rings.

**NOTE**

○*Do not mix up the top and second ring.*

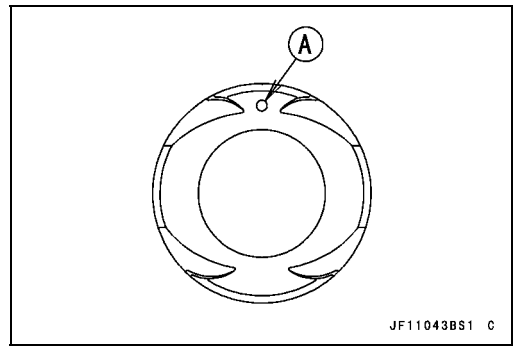
- Install the top ring [A] so that the "R" mark [B] faces up.
- Install the second ring [C] so that the "RN" mark [D] faces up.




**NOTE**

○*If a new piston is used, use new piston ring.*

- Install the piston with its dent mark [A] facing exhaust side.

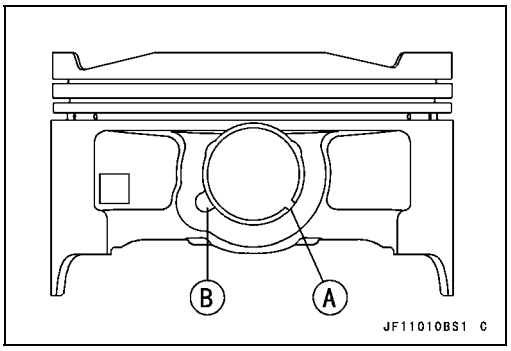


## Cylinder, Pistons

- Fit a new piston pin snap ring into the side of the piston so that the ring opening [A] does not coincide with the slit [B] of the piston pin hole.

○Apply molybdenum disulfide oil solution to the piston pins and piston journals.

○When installing the piston pin snap ring, compress it only enough to install it and no more.




**NOTICE**

**Snap rings are weakened and deform when removed and may fall out, scoring the cylinder wall and causing severe engine damage. Do not re-use snap rings, always replace them.**

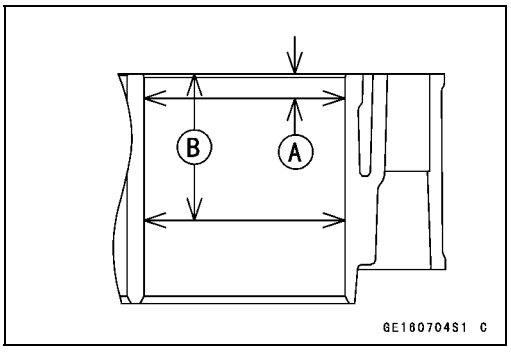
- Install the cylinder (see Cylinder Installation).

### *Cylinder Wear Inspection*

- Since there is a difference in cylinder wear in different directions, take a side-to-side and a front-to-back measurement at each of the two locations (total of four measurements) shown in the figure.

★If any of the cylinder inside diameter measurements exceeds the service limit, replace the cylinder.

10 mm (0.39 in.) [A]
60 mm (2.36 in.) [B]




**Cylinder Inside Diameter**

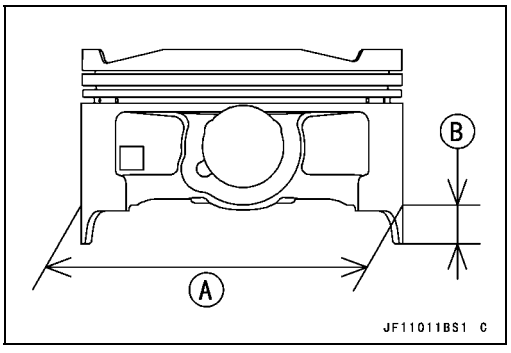
**Standard: 82.994 ~ 83.006 mm (3.2675 ~ 3.2679 in.)**

**Service Limit: 83.10 mm (3.272 in.)**

### *Piston Wear Inspection*

- Measure the outside diameter [A] of each piston 18 mm (0.71 in.) [B] up from the bottom of the piston at a right angle to the direction of the piston pin.

★If the measurement is under service limit, replace the piston.




**Piston Diameter**

**Standard: 82.919 ~ 82.934 mm (3.2645 ~ 3.2651 in.)**

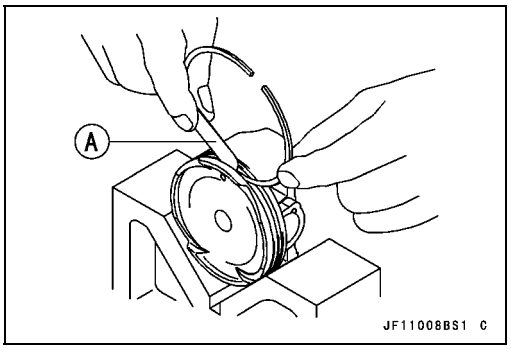
**Service Limit: 82.77 mm (3.259 in.)**

### *Piston Ring, Piston Ring Groove Wear Inspection*

- Check for uneven groove wear by inspecting the ring seating.

★The rings should fit perfectly parallel to groove surfaces. If not, replace the piston and all the piston rings.

- With the piston rings in their grooves, make several measurements with a thickness gauge [A] to determine piston ring/groove clearance.




**Piston Ring/Groove Clearance**

**Standard:**

**Top 0.03 ~ 0.07 mm (0.0012 ~ 0.0028 in.)**

**Second 0.02 ~ 0.06 mm (0.0008 ~ 0.0024 in.)**

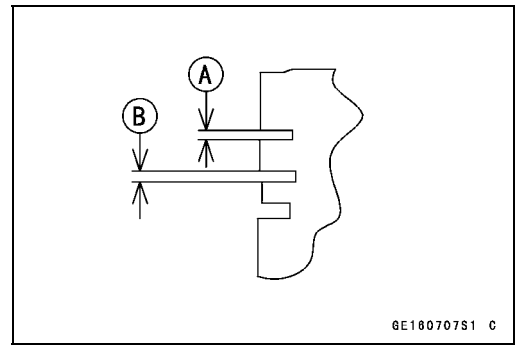
**Service Limit:**

**Top 0.17 mm (0.0067 in.)**

**Second 0.16 mm (0.0063 in.)**

## Cylinder, Pistons

### *Piston Ring Groove Width Inspection*

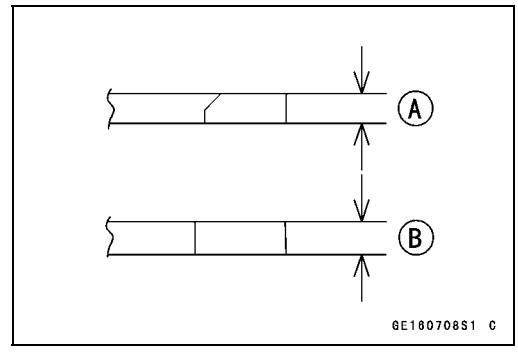



● Measure the piston ring groove width.
○Use a vernier caliper at several points around the piston.

**Piston Ring Groove Width**
**Standard:**
**Top [A] 0.92 ~ 0.94 mm (0.0362 ~ 0.0370 in.)**
**Second [B] 1.01 ~ 1.03 mm (0.0398 ~ 0.0406 in.)**
**Service Limit:**
**Top [A] 1.02 mm (0.0402 in.)**
**Second [B] 1.11 mm (0.0437 in.)**

★If the width of any of the two grooves is wider than the service limit at any point, replace the piston.

### *Piston Ring Thickness Inspection*




● Measure the piston ring thickness.
○Use the micrometer to measure at several points around the ring.

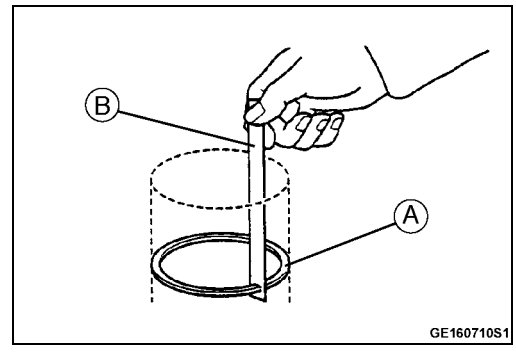
**Piston Ring Thickness**
**Standard:**
**Top [A] 0.87 ~ 0.89 mm (0.0343 ~ 0.0350 in.)**
**Second [B] 0.97 ~ 0.99 mm (0.0382 ~ 0.0390 in.)**
**Service Limit:**
**Top [A] 0.80 mm (0.0315 in.)**
**Second [B] 0.90 mm (0.0354 in.)**

★If any of the measurements is less than the service limit on either of the rings, replace all the rings.

**NOTE**

○*When using new rings in a used piston, check for uneven groove wear. The rings should fit perfectly parallel to the groove sides. If not, replace the piston.*

### *Piston Ring End Gap Inspection*




● Place the piston ring [A] inside the cylinder, using the piston to locate the ring squarely in place. Set it close to the bottom of the cylinder, where cylinder wear is low.
● Measure the gap between the ends of the ring with a thickness gauge [B].

**Piston Ring End Gap**
**Standard:**
**Top 0.25 ~ 0.40 mm (0.0098 ~ 0.0157 in.)**
**Second 0.40 ~ 0.55 mm (0.0157 ~ 0.0217 in.)**
**Service Limit:**
**Top 0.7 mm (0.028 in.)**
**Second 0.8 mm (0.031 in.)**

★If the end gap of either ring is greater than the service limit, replace all the rings.

# Engine Removal/Installation

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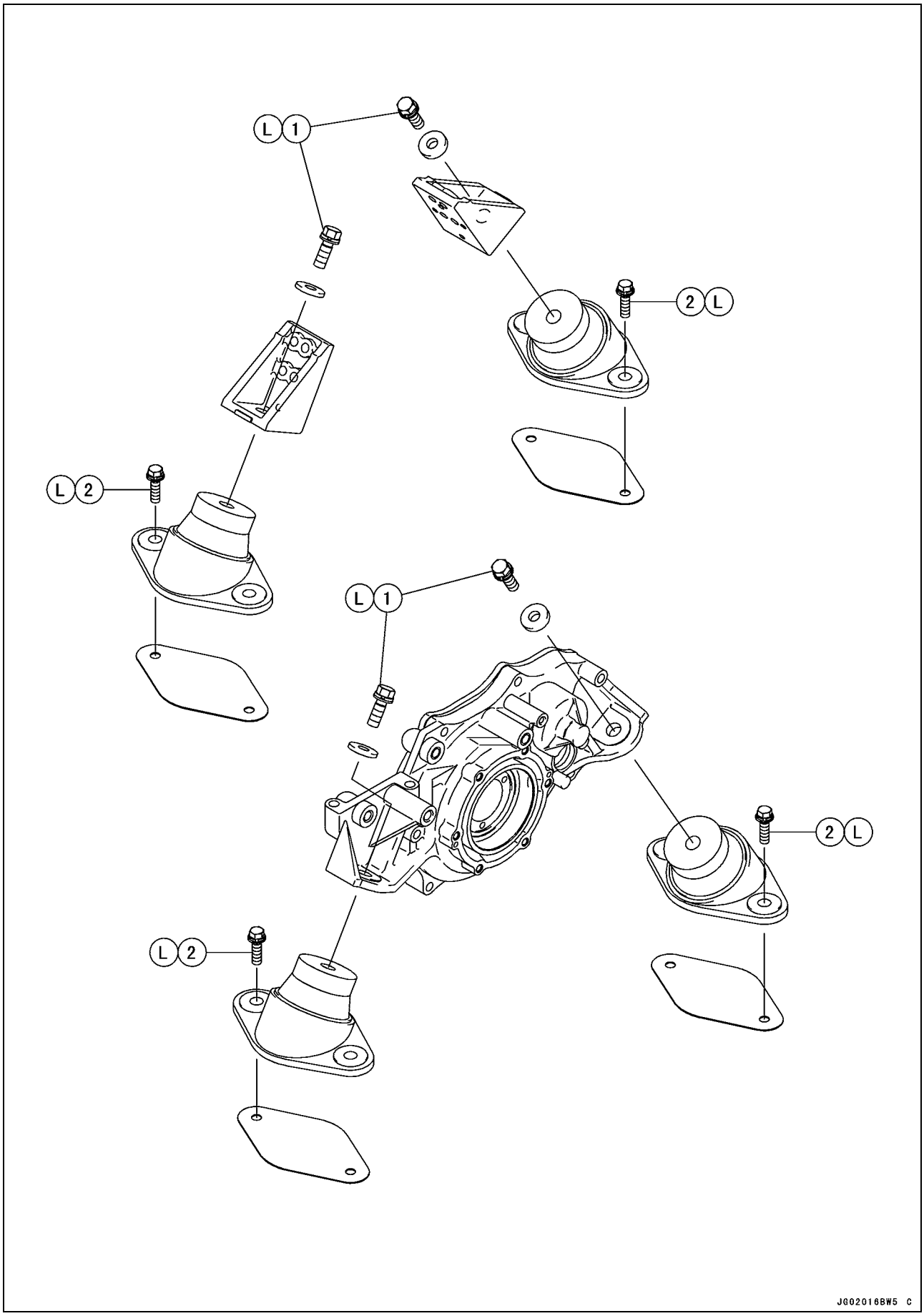
## Exploded View



## Exploded View

| No. | Fastener | Torque | | | Remarks |
|---|---|---|---|---|---|
| | | N·m | kgf·m | ft·lb | |
| 1 | Engine Mounting Bolts | 36.3 | 3.7 | 27 | L |
| 2 | Engine Damper Mounting Bolts | 15.7 | 1.6 | 12 | L |

L: Apply a non-permanent locking agent.

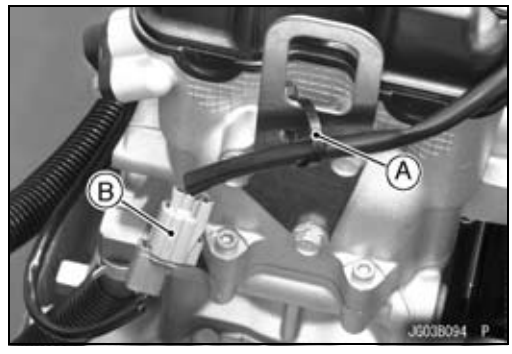
## Engine Removal/Installation

### *Engine Removal*

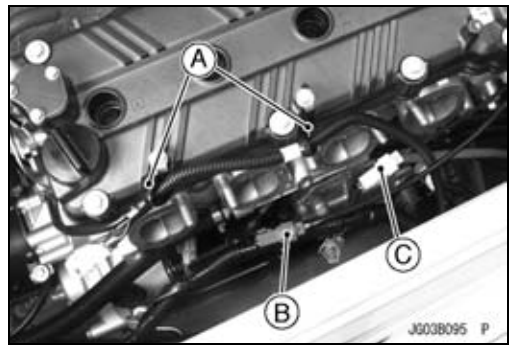
★If the engine is to be disassembled after removal, drain the engine oil (see Engine Oil Change in the Periodic Maintenance chapter).

● Remove:
Seats (see Seat Removal in the Hull/Engine Hood chapter)
Handrail Plate (see Handrail Plate Removal in the Hull/Engine Hood chapter)
Oil Separator Tank (see Oil Separator Tank Removal in the Engine Lubrication System chapter)
Air Box (see Air Box Removal in the Fuel System (DFI) chapter)
Intake Manifold (see Intake Manifold Removal in the Fuel System (DFI) chapter)
Exhaust Manifold with Exhaust Pipe (see Exhaust Manifold Removal in the Exhaust System chapter)

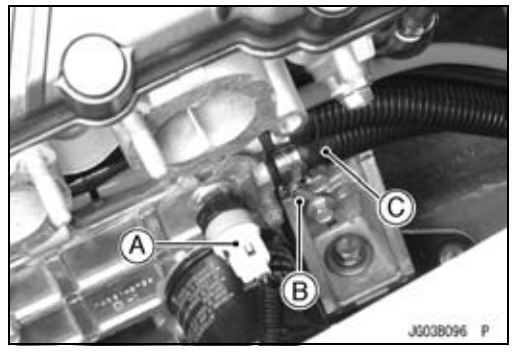
● Cut the band [A].
● Disconnect:
Camshaft Sensor Lead Connector [B]




● Free the main harness from the clamps [A].
● Disconnect:
Crankshaft Sensor Lead Connector [B]
Oil Temperature Sensor Lead Connector [C]

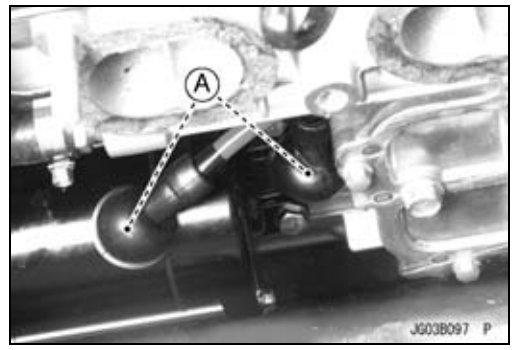



● Disconnect:
Oil Pressure Switch Connector [A]
● Loosen the clamp screw [B] and remove the water hose [C].



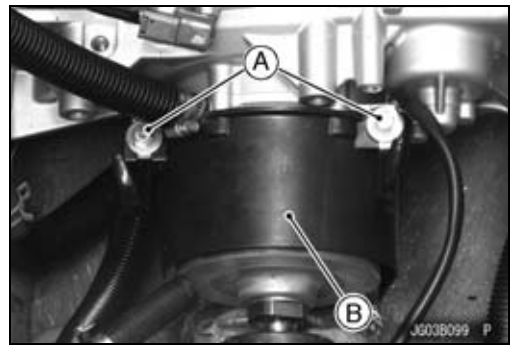
## Engine Removal/Installation

- Disconnect:
  Starter Motor Terminals [A]

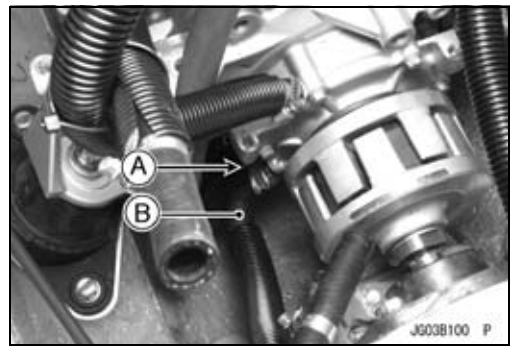



- Disconnect:
  Alternator Lead Connector [A]

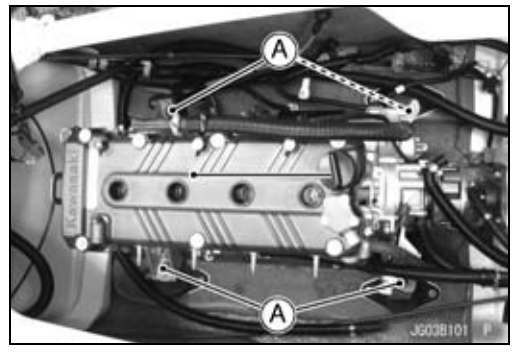
- Remove:
  Bolts [A] and Clamps
  Coupling Cover [B]




- Loosen the clamp screw [A] and remove the water hose [B].

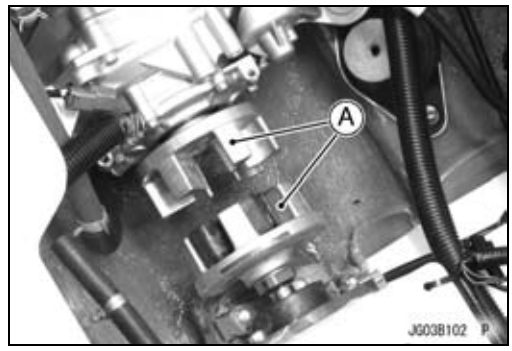



- Remove the engine mounting bolts [A].

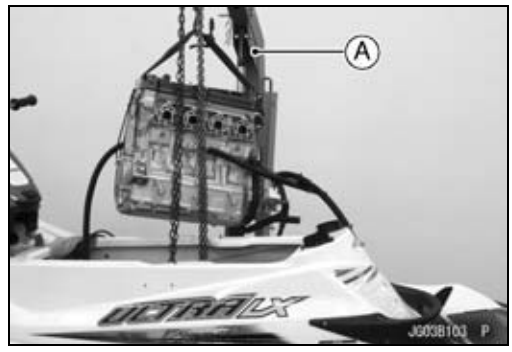


## Engine Removal/Installation

- Move the engine forward to separate the couplings [A].




- Lift the engine with a lifter [A] and remove the engine as shown in the figure.

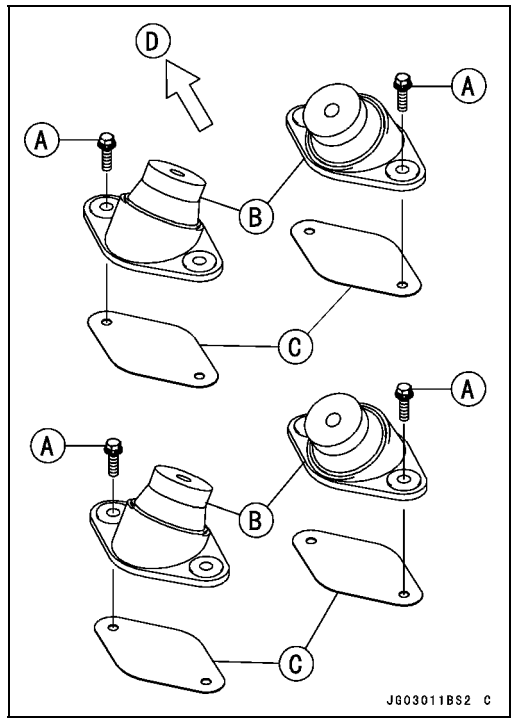



### *Engine Damper Removal*

- Remove:
  Engine Damper Mounting Bolts [A]
  Engine Damper [B]
  Shim [C] (0 ~ 3 pieces)
  Bow [D]
- Record the number of shims of four positions so that they can be put back in the same position.

**NOTICE**

**Incorrect shims could cause drive shaft misalignment. Install the shims to the same position.**




### *Engine Damper Installation*

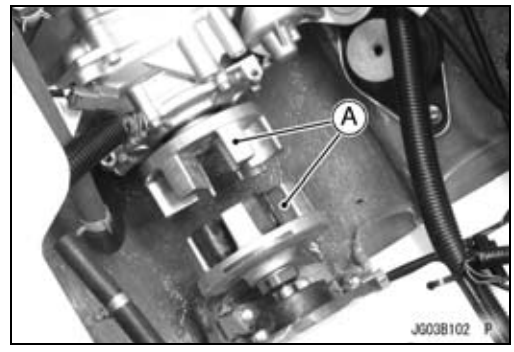
- Install the shim(s) of the same number.
- Apply a non-permanent locking agent to the engine damper mounting bolts, and tighten them.

**Torque - Engine Damper Mounting Bolts: 15.7 N·m (1.6 kgf·m, 12 ft·lb)**

### *Engine Installation*

- Be sure there are no foreign objects and parts inside of the hull.
- Clean the bilge filters (see Filter Cleaning and Inspection in the Cooling and Bilge Systems chapter).
- Inspect the coupling damper (see Coupling Damper Inspection in the Periodic Maintenance chapter).

## Engine Removal/Installation




- Installation is the reverse of removal. Note the following.
- Put the engine onto the hull with a lifter.
- Move the engine backward to engage the couplings [A].
- Apply a non-permanent locking agent to the engine mounting bolts and tighten them.

**Torque - Engine Mounting Bolts: 36.3 N·m (3.7 kgf·m, 27 ft·lb)**

- Run the leads and the hoses properly (see Cable, Wire, and Hose Routing section in the Appendix chapter).
- Install the removed parts (see appropriate chapters).

- After installing the engine in the hull, check the following.
  Throttle Cable
  Fuel and Exhaust Leaks

**⚠ DANGER**

**Exhaust gas contains carbon monoxide, a colorless, odorless poisonous gas. Inhaling carbon monoxide can cause serious brain injury or death. DO NOT run the engine in enclosed areas. Operate only in a well-ventilated area.**

***NOTICE***

**Operating the engine without cooling water for more than 15 seconds, especially at high rpm, will cause severe engine and exhaust system damage. To avoid engine damage, do not run the engine without providing sufficient cooling water.**

# Engine Bottom End

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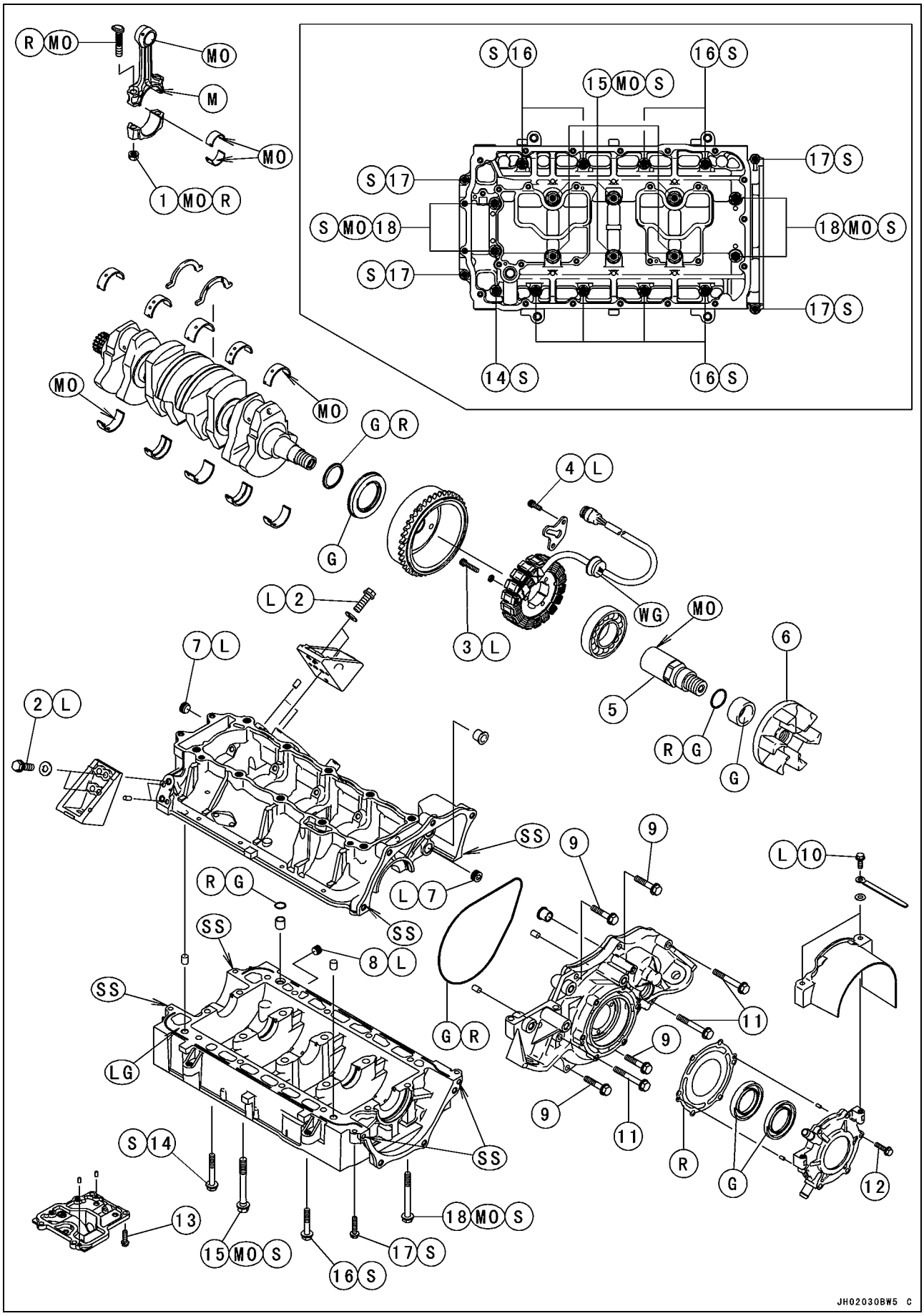
## Exploded View



## Exploded View

| No. | Fastener | Torque | | | Remarks |
|---|---|---|---|---|---|
| | | N·m | kgf·m | ft·lb | |
| 1 | Connecting Rod Nuts | see text | ← | ← | MO, R |
| 2 | Engine Bracket Mounting Bolts | 32 | 3.3 | 24 | L |
| 3 | Stator Coil Mounting Bolts | 12 | 1.2 | 106 in·lb | L |
| 4 | Stator Coil Grommet Holder Plate Bolts | 8.8 | 0.90 | 78 in·lb | L |
| 5 | Output Shaft | 265 | 27.0 | 195 | MO |
| 6 | Coupling | 110 | 11.2 | 81 | |
| 7 | Oil Passage Plugs (R3/8) | 20 | 2.0 | 15 | L |
| 8 | Oil Passage Plug (R1/4) | 7.8 | 0.80 | 69 in·lb | L |
| 9 | Alternator Cover Bolts (L = 40 mm) | 20 | 2.0 | 15 | |
| 10 | Coupling Cover Bolts | 8.8 | 0.90 | 78 in·lb | L |
| 11 | Alternator Cover Bolts (L = 60 mm) | 20 | 2.0 | 15 | |
| 12 | Output Cover Bolts | 7.8 | 0.80 | 69 in·lb | |
| 13 | Oil Catch Cover Bolts | 7.8 | 0.80 | 69 in·lb | |
| 14 | Crankcase Bolt (M8, L = 55 mm) | 30 | 3.1 | 22 | S |
| 15 | Crankcase Bolts (M10) | 50 | 5.1 | 37 | MO, S |
| 16 | Crankcase Bolts (M8, L = 45 mm) | 30 | 3.1 | 22 | S |
| 17 | Crankcase Bolts (M6) | 12 | 1.2 | 106 in·lb | S |
| 18 | Crankcase Bolts (M8, L = 85 mm) | 30 | 3.1 | 22 | MO, S |

G: Apply grease.
L: Apply a non-permanent locking agent.
LG: Apply liquid gasket.
M: Apply molybdenum disulfide grease.
MO: Apply molybdenum disulfide oil solution.
(mixture of engine oil and molybdenum disulfide grease in a weight ratio is 10:1)
R: Replacement Parts
S: Follow the specified tightening sequence.
SS: Apply silicone sealant.
WG: Apply water-resistance grease.

## Specifications

| Item | Standard | Service Limit |
|---|---|---|
| **Crankshaft, Connecting Rods** | | |
| Connecting Rod Bend | – – – | 0.2/100 mm (0.008/3.94 in.) |
| Connecting Rod Twist | – – – | 0.2/100 mm (0.008/3.94 in.) |
| Connecting Rod Big End Side Clearance | 0.13 ~ 0.38 mm (0.0051 ~ 0.0150 in.) | 0.6 mm (0.024 in.) |
| Connecting Rod Big End Bearing Insert/Crankpin Clearance | 0.041 ~ 0.071 mm (0.0016 ~ 0.0028 in.) | 0.11 mm (0.0043 in.) |
| Crankpin Diameter: | 38.984 ~ 39.000 mm (1.53480 ~ 1.53543 in.) | 38.97 mm (1.5342 in.) |
| Marking: | | |
| None | 38.984 ~ 38.992 mm (1.53480 ~ 1.53512 in.) | – – – |
| ○ | 38.993 ~ 39.000 mm (1.53515 ~ 1.53543 in.) | – – – |
| Connecting Rod Big End Inside Diameter: | 42.000 ~ 42.016 mm (1.65354 ~ 1.65417 in.) | – – – |
| Marking | | |
| None | 42.000 ~ 42.008 mm (1.65354 ~ 1.65385 in.) | – – – |
| ○ | 42.009 ~ 42.016 mm (1.65389 ~ 1.65417 in.) | – – – |
| Connecting Rod Big End Bearing Insert Thickness: | | |
| Pink | 1.475 ~ 1.480 mm (0.05807 ~ 0.05827 in.) | – – – |
| Yellow | 1.480 ~ 1.485 mm (0.05827 ~ 0.05846 in.) | – – – |
| Green | 1.485 ~ 1.490 mm (0.05846 ~ 0.05866 in.) | – – – |

**Connecting Rod Big End Bearing Insert Selection**

| Connecting Rod Big End Inside Diameter Marking | Crankpin Diameter Marking | Bearing Insert | |
|---|---|---|---|
| | | Size Color | Part Number |
| None | ○ | Pink | 92139-0724 |
| None | None | Yellow | 92139-0723 |
| ○ | ○ | | |
| ○ | None | Green | 92139-0722 |

| | | |
|---|---|---|
| Crankshaft Side Clearance | 0.05 ~ 0.24 mm (0.0020 ~ 0.0094 in.) | 0.44 mm (0.017 in.) |
| Crankshaft #3 Main Journal Width | 27.45 ~ 27.55 mm (1.081 ~ 1.085 in.) | – – – |
| Crankshaft Runout | TIR 0.03 mm (0.0012 in.) or less | TIR 0.07 mm (0.0028 in.) |

## Specifications

| Item | Standard | Service Limit |
|---|---|---|
| Crankshaft Main Bearing Insert/Journal Clearance | 0.030 ~ 0.054 mm (0.0012 ~ 0.0021 in.) | 0.08 mm (0.0031 in.) |
| Crankshaft Main Journal Diameter: | 40.984 ~ 41.000 mm (1.61354 ~ 1.61417 in.) | 40.96 mm (1.6126 in.) |
| Marking | | |
| None | 40.984 ~ 40.992 mm (1.61354 ~1.61386 in.) | – – – |
| 1 | 40.993 ~ 41.000 mm (1.61389 ~ 1.61417 in.) | – – – |
| Crankcase Main Bearing Inside Diameter: | 44.000 ~ 44.016 mm (1.73228 ~ 1.73290 in.) | – – – |
| Marking | | |
| ○ | 44.000 ~ 44.008 mm (1.73228 ~ 1.73259 in.) | – – – |
| None | 44.009 ~ 44.016 mm (1.73263 ~ 1.73290 in.) | – – – |
| Crankshaft Main Bearing Insert Thickness: | | |
| Pink | 1.490 ~ 1.494 mm (0.05866 ~ 0.05882 in.) | – – – |
| Yellow | 1.494 ~ 1.498 mm (0.05882 ~ 0.05898 in.) | – – – |
| Green | 1.498 ~ 1.502 mm (0.05898 ~ 0.05913 in.) | – – – |

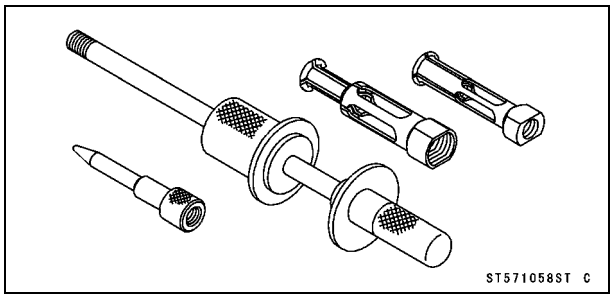
**Crankshaft Main Bearing Insert Selection**

| Crankcase Main Bearing Inside Diameter Marking | Crankshaft Main Journal Diameter Marking | Bearing Insert* | | |
|---|---|---|---|---|
| | | Size Color | Part Number | Journal Nos. |
| ○ | 1 | Pink | 92139-0727 | 1, 5 |
| | | | 92139-0730 | 2, 4 |
| | | | 92139-0733 | 3 |
| ○ | None | Yellow | 92139-0726 | 1, 5 |
| None | 1 | | 92139-0729 | 2, 4 |
| | | | 92139-0732 | 3 |
| None | None | Green | 92139-0725 | 1, 5 |
| | | | 92139-0728 | 2, 4 |
| | | | 92139-0731 | 3 |

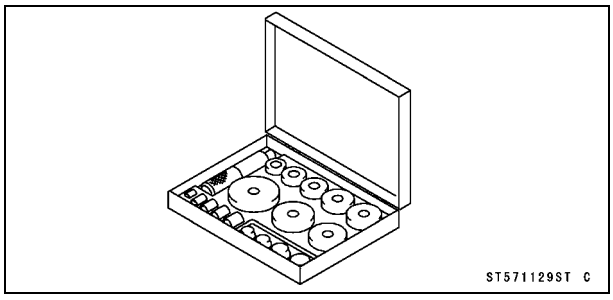
*The bearing inserts for Nos. 2 and 4 journals have an oil groove.

## Special Tools and Sealant

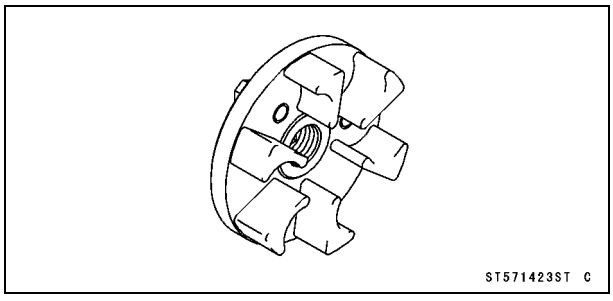
**Oil Seal & Bearing Remover:**
**57001-1058**



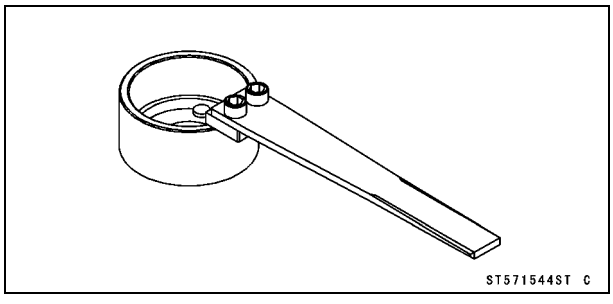

**Bearing Driver Set:**
**57001-1129**



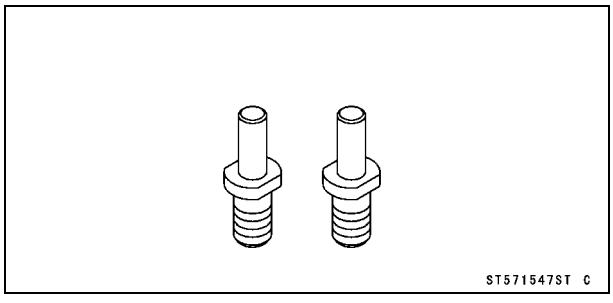

**Coupling Holder #2:**
**57001-1423**



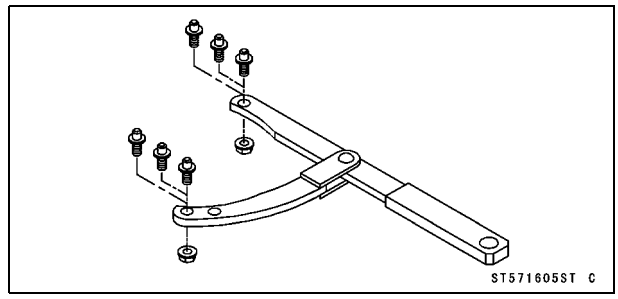

**Rotor Holder:**
**57001-1544**



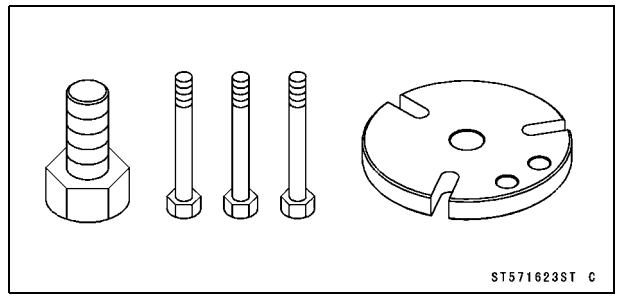

**Holder Attachment:**
**57001-1547**



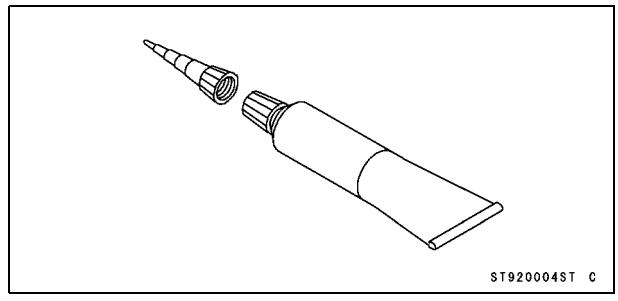

**Flywheel & Pulley Holder:**
**57001-1605**



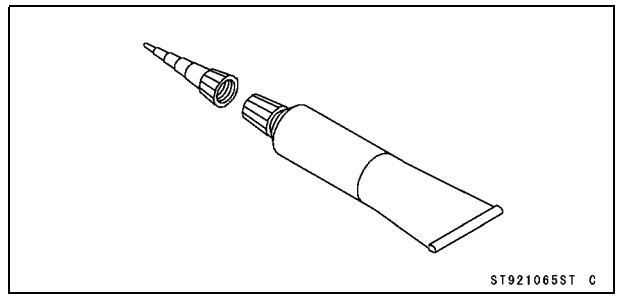

**Rotor Puller:**
**57001-1623**




**Liquid Gasket, TB1211F:**
**92104-0004**

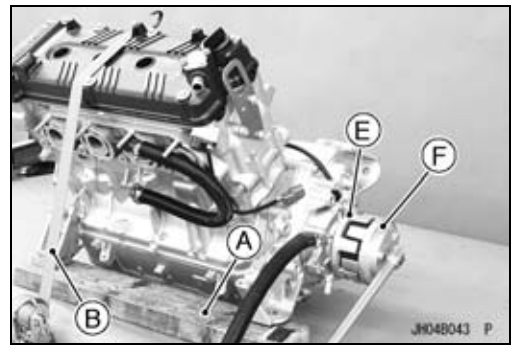



**Liquid Gasket, TB1215:**
**92104-1065**

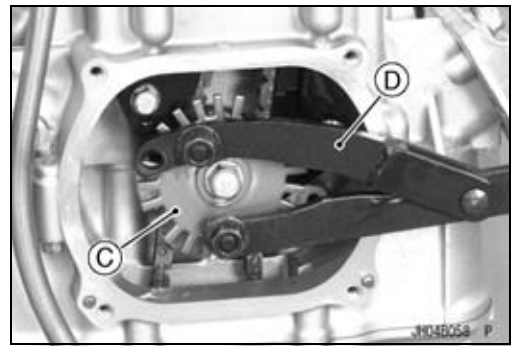


## Coupling/Output Shaft

### *Coupling Removal*

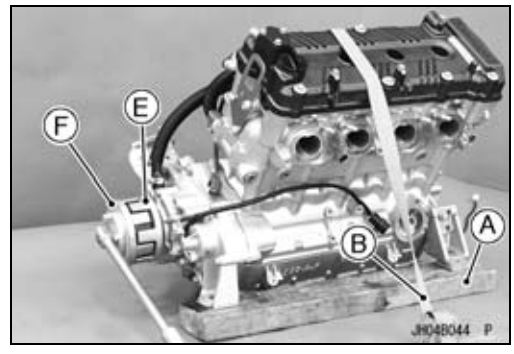



- Remove:
  Engine (see Engine Removal in the Engine Removal/Installation chapter)
  Starter Motor (see Starter Motor Removal in the Electrical System chapter)
  Oil Cooler (see Oil Cooler Removal in the Engine Lubrication System chapter)
  Crankshaft Sensor Cover (see Crankshaft Sensor Removal in the Electrical System chapter)
- Place the wooden block [A] under the engine mounting brackets on the exhaust side.
- Hold the engine with a suitable belt [B] tightly.
- While holding the timing rotor [C] with the flywheel & pulley holder [D], loosen the coupling [E] with the coupling holder [F].




**Special Tools - Coupling Holder #2: 57001-1423**
**Holder Attachment: 57001-1547**
**Flywheel & Pulley Holder: 57001-1605**

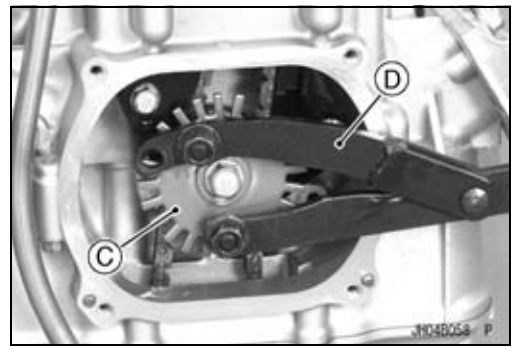
### *Coupling Installation*



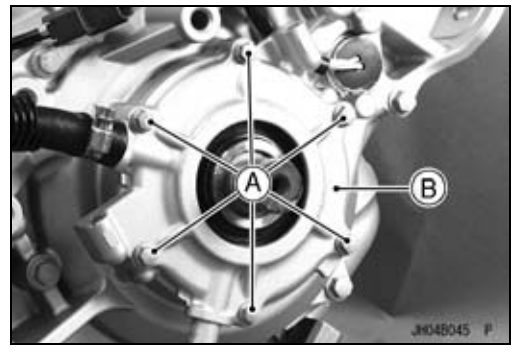

- Place the wooden block [A] under the engine mounting brackets on the intake side.
- Hold the engine with a suitable belt [B] tightly.
- While holding the timing rotor [C] with the flywheel & pulley holder [D], tighten the coupling [E] with the coupling holder [F].

**Special Tools - Coupling Holder #2: 57001-1423**
**Holder Attachment: 57001-1547**
**Flywheel & Pulley Holder: 57001-1605**

**Torque - Coupling: 110 N·m (11.2 kgf·m, 81 ft·lb)**



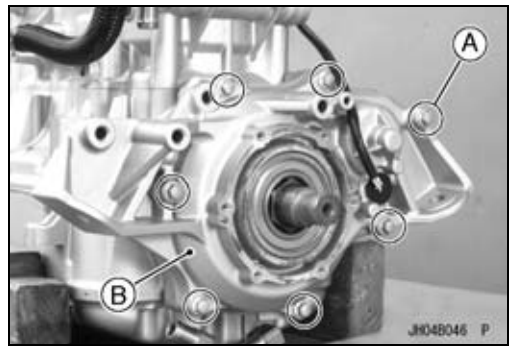

### *Output Shaft Removal*



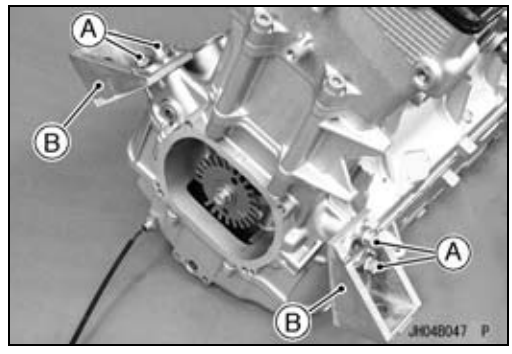

- Remove:
  Coupling (see Coupling Removal)
  Output Cover Bolts [A]
  Output Cover [B]

## Coupling/Output Shaft

- Remove:
  Alternator Cover Bolts [A]
  Alternator Cover [B]

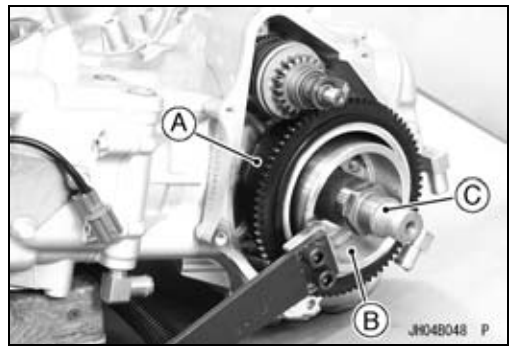



- Remove:
  Engine Bracket Mounting Bolts [A]
  Engine Brackets [B]




- Place the wooden block under the engine to avoid damage to the engine.
- Turn the engine so that the intake ports face upward.
- Hold the engine with a suitable belt tightly.
- While holding the alternator rotor [A] with the rotor holder [B], remove the output shaft [C].

**Special Tool - Rotor Holder: 57001-1544**

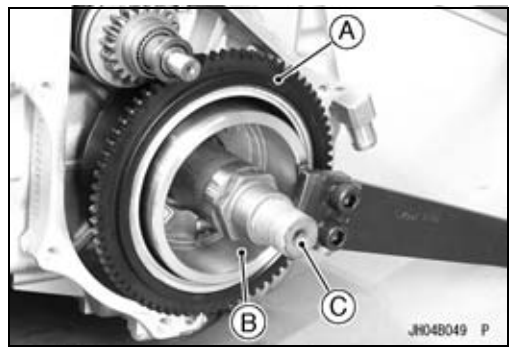



### *Output Shaft Installation*

- Turn the engine so that the exhaust ports face upward.
- Place the wooden block under the engine to avoid damage to the engine.
- Hold the engine with a suitable belt tightly.
- Apply molybdenum disulfide oil solution to the seating surface of the output shaft.
- While holding the alternator rotor [A] with the rotor holder [B], tighten the output shaft [C].

**Special Tool - Rotor Holder: 57001-1544**

**Torque - Output Shaft: 265 N·m (27.0 kgf·m, 195 ft·lb)**

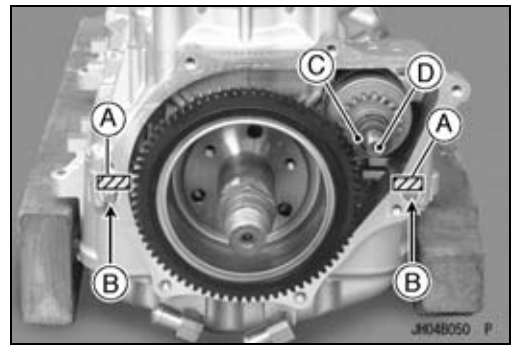


## Coupling/Output Shaft

● Apply silicone sealant [A] to the crankcase halves mating surfaces on the alternator cover.

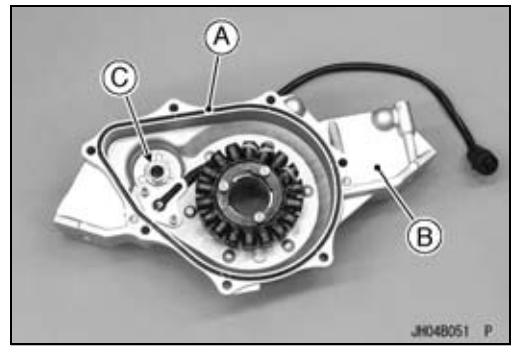
**Sealant - Liquid Gasket, TB1211F: 92104-0004**

● Be sure to install the dowel pins [B].
● Be sure to install the washer [C] on the reduction gear shaft.
● Apply molybdenum disulfide grease to the reduction gear shaft [D].

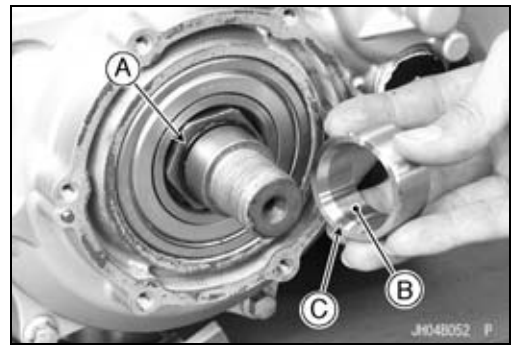



● Replace the O-ring [A] with a new one.
● Apply grease to the O-ring, and fit the O-ring onto the groove of the alternator cover [B].
● Install the alternator cover.
○Be sure to install the bushing [C] into the hole.

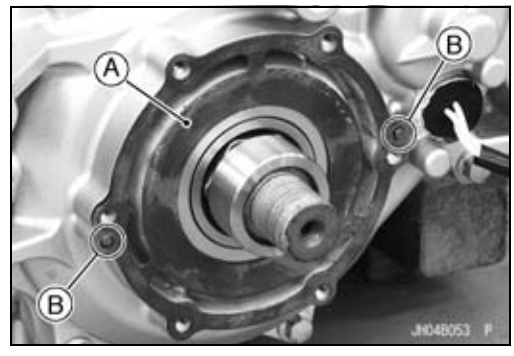
**Torque - Alternator Cover Bolts: 20 N·m (2.0 kgf·m, 15 ft·lb)**




● Replace the O-ring [A] with a new one.
● Apply grease to the O-ring and collar inside [B].
● Install the collar so that the chamfer side [C] faces inward.



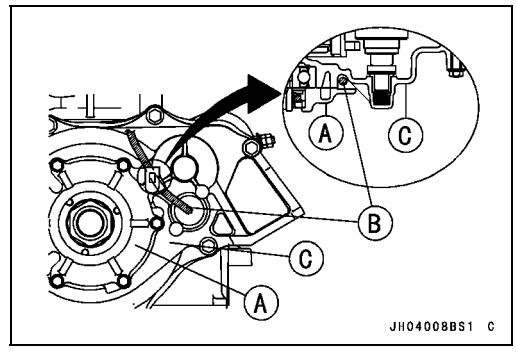

● Replace the gasket [A] with a new one.
● Install:
Dowel Pins [B]
Gasket




● Apply grease to the oil seal lip on the output cover.
● Install the output cover [A].
● Tighten:

**Torque - Output Cover Bolts: 7.8 N·m (0.80 kgf·m, 69 in·lb)**

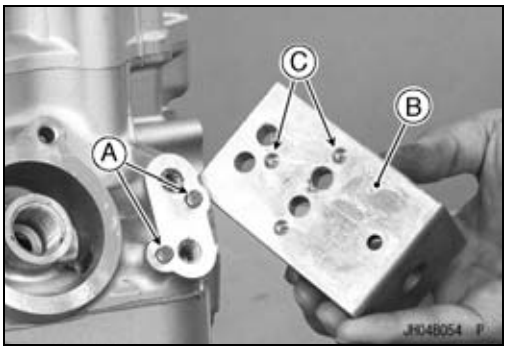
○Run the stator coil lead [B] between the alternator cover [C] and the output cover as shown in the figure.



## Coupling/Output Shaft

- Install the dowel pins [A].
- Install the engine brackets [B] so that the holes [C] fit the dowel pins.
- Apply a non-permanent locking agent to the thread of the engine bracket mounting bolts.
- Tighten:

**Torque - Engine Bracket Mounting Bolts: 32 N·m (3.3 kgf·m, 24 ft·lb)**



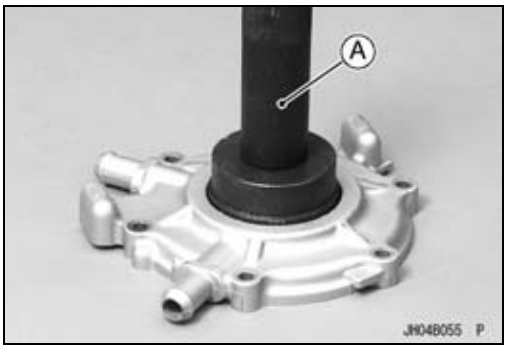

### *Coupling Damper Inspection*

- Refer to Coupling Damper Inspection in the Periodic Maintenance chapter.

### *Output Cover Oil Seal Replacement*

- Remove:
  Output Cover (see Output Shaft Removal)
- Using the bearing driver [A], remove the oil seals as a set.

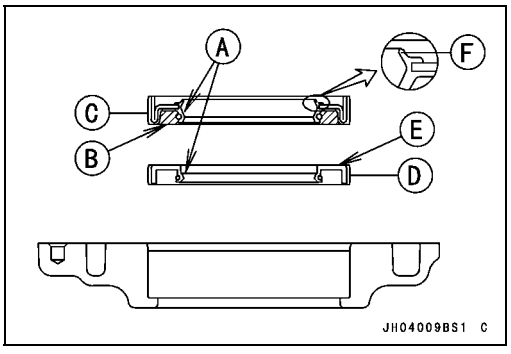
**Special Tool - Bearing Driver Set: 57001-1129**




- Replace the oil seals with new ones.
- Apply thin coat grease to the oil seal lips [A].
- Pack grease [B] between the oil seal lip and housing of the oil seal (engine inside oil seal [C]).
- Press in the oil seals until they are bottomed.

**Special Tool - Bearing Driver Set: 57001-1129**

- Install the oil seal [D] so that the manufacturer's mark [E] faces outside.
- Install the engine inside oil seal so that the dust seal [F] side faces outside.




### *Oil Seal Inspection*

- Inspect the oil seal.

★Replace it if the lips are misshapen, discolored (indicating that the rubber has deteriorated), hardened or otherwise damaged.

### *Alternator Cover Bearing Replacement*

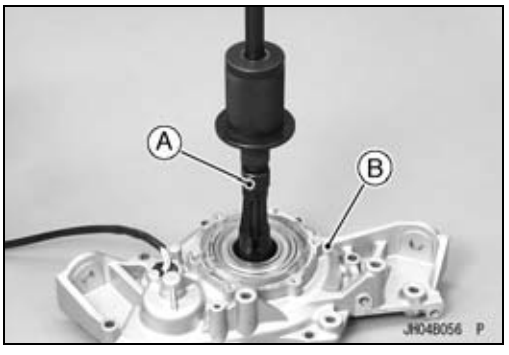
**NOTICE**

**Removing the ball bearing may damage it. Do not remove the ball bearing unless absolutely necessary.**

- Remove:
  Alternator Cover (see Output Shaft Removal)
- Using the oil seal & bearing remover [A], remove the ball bearing from the alternator cover [B].

○When removing the ball bearing, hold the alternator cover.

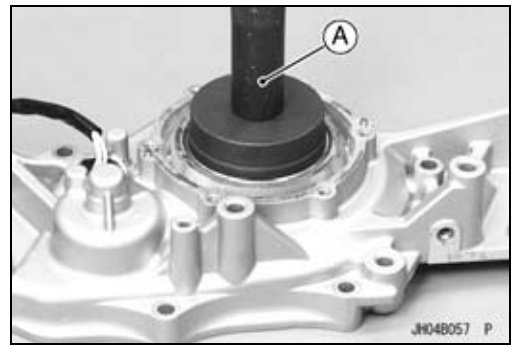
**Special Tool - Oil Seal & Bearing Remover: 57001-1058**



## Coupling/Output Shaft

● Using a press and the bearing driver set [A], install the new bearing until it stops at the bottom of its housing.

**Special Tool - Bearing Driver Set: 57001-1129**




### *Ball Bearing Lubrication*

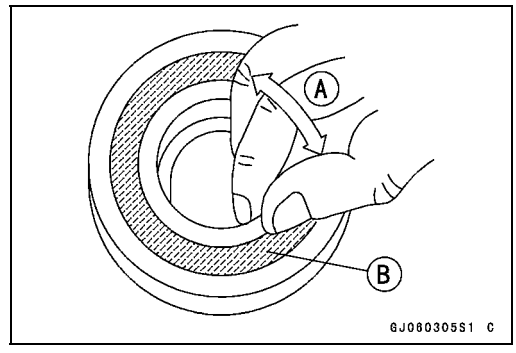
**NOTE**

○*Since the bearings are packed with grease and sealed on both sides, lubrication is not required.*

### *Ball Bearing Inspection*

**NOTE**

○*It is not necessary to remove the bearings for inspection. If the bearing is removed, it will need to be replaced with a new one.*




● Spin [A] it by hand to check its condition.

★If it is noisy, does not spin smoothly, or has any rough spots, it must be replaced.

● Examine the bearing seal [B] for tears or leakage.

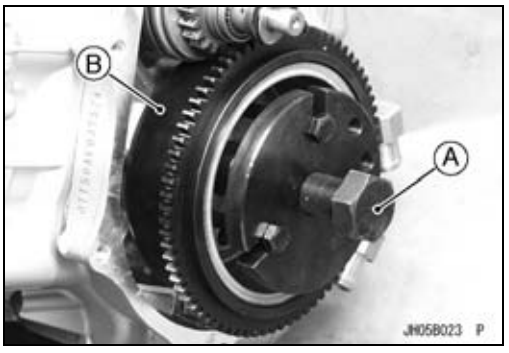
★If the seal is torn or is leaking, replace the bearing.

## Alternator Rotor

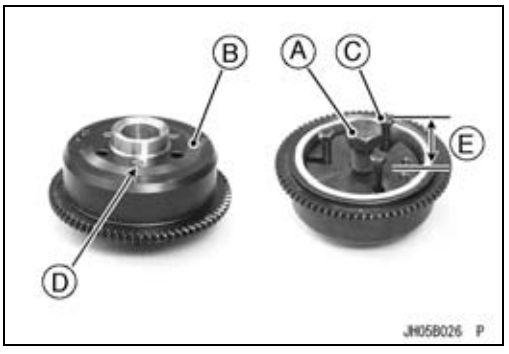
### *Alternator Rotor Removal*

- Remove:
  Output Shaft (see Output Shaft Removal)
- Using the rotor puller [A], remove the alternator rotor [B] from the crankshaft.

**Special Tool - Rotor Puller: 57001-1623**




○Tighten the rotor puller bolts [C] until the bottom surfaces of the bolts are flush [D] with the surface of the alternator rotor as shown in the figure (For reference, the photo shows the alternator rotor removed from the crankshaft.).
○The bolt length will be about 63 mm (2.5 in.) [E] after tightened.




**NOTICE**

**Overtightening the bolts can damage the crankcase oil seal.**

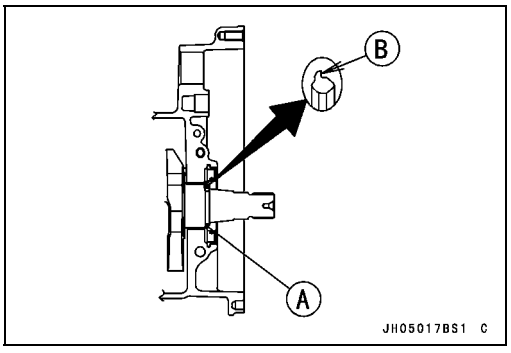
**NOTICE**

**Do not attempt to strike the alternator rotor itself. Striking the rotor can cause the magnets to lose their magnetism.**

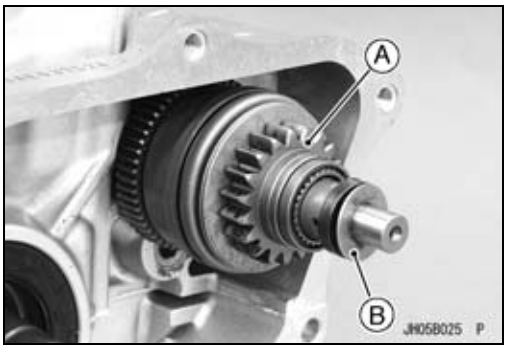
### *Alternator Rotor Installation*

- Using a high-flash points solvents, clean off any oil or dirt that may be on the crankshaft taper and in the tapered hole in the alternator rotor.
- Replace the O-ring [A] with a new one, and install it as shown in the figure.

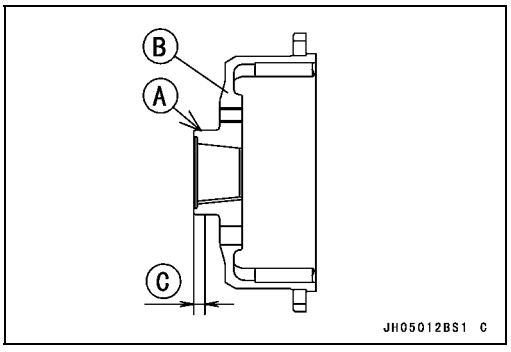
○This face [B] is alternator rotor side.




★If the reduction gear [A] is removed, apply a molybdenum disulfide grease to both ends of its shaft.
- Install the reduction gear and the washer [B].

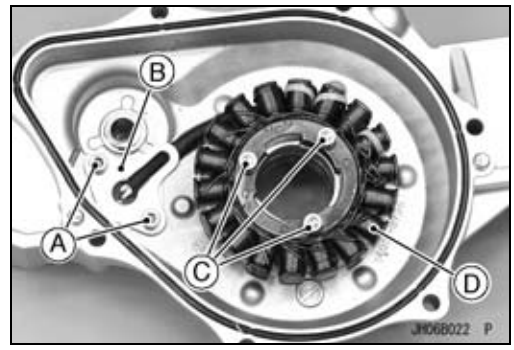



- Apply grease to the boss outside [A] of the alternator rotor [B].
  10 mm (0.39 in.) [C]
- Install the alternator rotor to the crankshaft.
- Install the output shaft (see Output Shaft Installation).



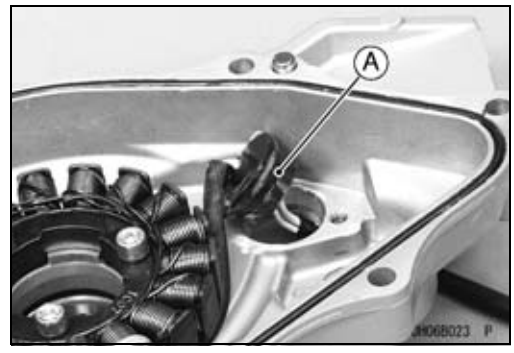
## Stator Coil

### *Stator Coil Removal*




- Remove:
  Alternator Cover (see Output Shaft Removal)
  Stator Coil Grommet Holder Plate Bolts [A]
  Grommet Holder Plate [B]
  Stator Coil Mounting Bolts [C] with Washers
  Stator Coil [D]

### *Stator Coil Installation*




- Apply water-resistance grease to the outside of the grommet [A].
- Apply a non-permanent locking agent to the stator coil grommet holder plate bolts and tighten them.

**Torque - Stator Coil Grommet Holder Plate Bolts: 8.8 N·m (0.90 kgf·m, 78 in·lb)**

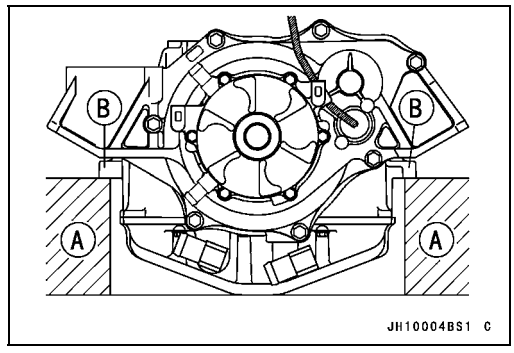
- Apply a non-permanent locking agent to the stator coil mounting bolts and put the washers.
- Tighten:

**Torque - Stator Coil Mounting Bolts: 12 N·m (1.2 kgf·m, 106 in·lb)**

○When installing the stator coil, fix the stator coil lead to the groove of the alternator cover.
○Be sure to the stator coil lead have no slack and bite.

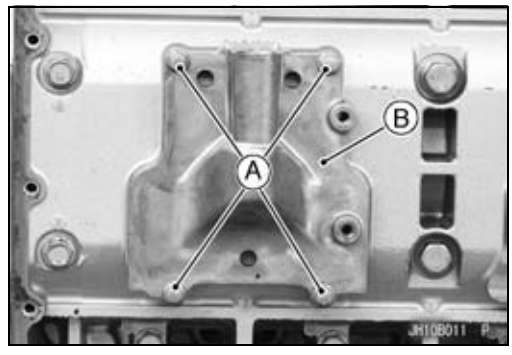
## Crankcase Splitting

### *Crankcase Splitting*




- Remove:
  Engine (see Engine Removal in the Engine Removal/Installation chapter)
- Drain the engine oil (see Engine Oil Change in the Periodic Maintenance chapter).
- Set the engine on a clean surface and hold the engine steady while parts are being removed.
  Suitable Blocks [A]
  Lower Crankcase Projections [B]

- Remove:
  Oil Cooler (see Oil Cooler Removal in the Engine Lubrication System chapter)
  Pistons (see Piston Removal in the Engine Top End chapter)
  Starter Motor (see Starter Motor Removal in the Electrical System chapter)
  Oil Pump Sprocket (see Oil Pump Sprocket Removal in the Engine Lubrication System chapter)
  Oil Pump Chain (see Oil Pump Chain Removal in the Engine Lubrication System chapter)
  Alternator Rotor (see Alternator Rotor Removal)

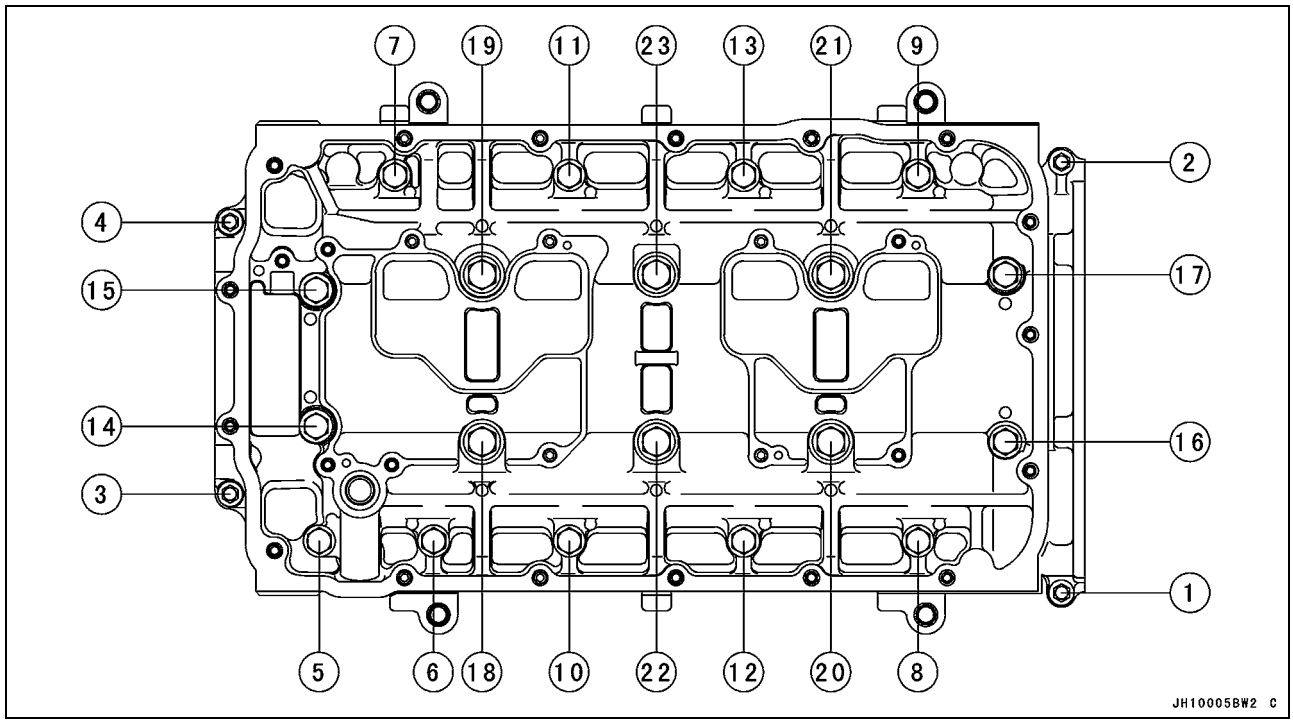



- Turn the engine upside down.
- Remove:
  Bolts [A]
  Oil Catch Cover [B]

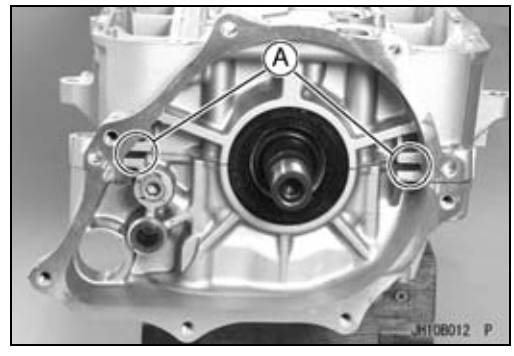
## Crankcase Splitting

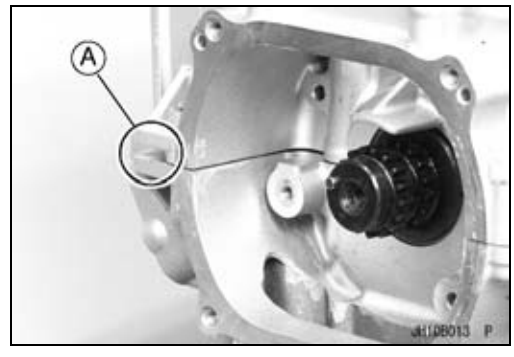
- Remove the crankcase bolts following the specified sequence.

○First, loosen the M6 bolts [1 ~ 4].
○Second, loosen the M8 bolts [5 ~ 17].
○Lastly, loosen the M10 bolts [18 ~ 23].



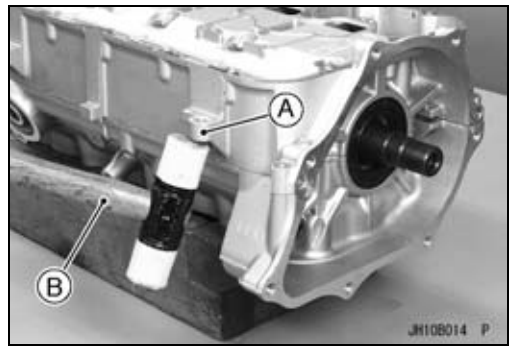

- Using the pry points [A], split the crankcase halves.



## Crankcase Splitting

- Tap lightly at the lower crankcase projections [A] with a plastic mallet [B].
- Lift off the lower crankcase half to remove it.




### *Crankcase Assembly*

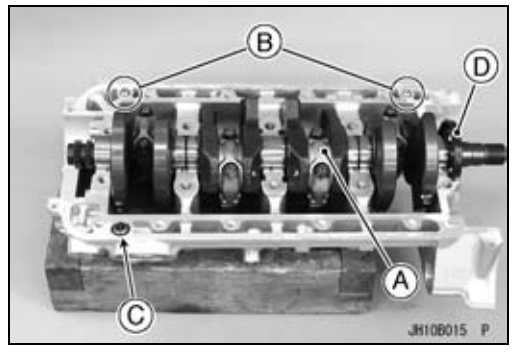
***NOTICE***

**The upper and lower crankcase halves are machined at the factory in the assembled state, so the crankcase halves must be replaced as a set.**

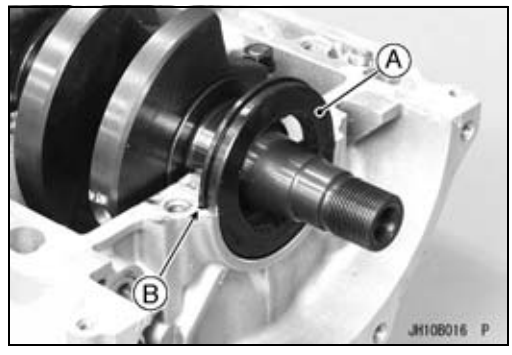
- With high flash-point solvent, clean off the mating surfaces of the crankcases halves and wipe dry.
- Using compressed air, blow out the oil passages in the crankcase halves.

- Replace the O-ring with a new one.
- Install:
  Crankshaft and Connecting Rods [A] (see Crankshaft Installation)
  Dowel Pins [B]
  Oil Passage Pipe [C] with New O-ring
  Oil Seal [D]

○Apply grease to the new O-ring.




- Check to see that the oil seal [A] is in the groove [B] of the crankcase.



## Crankcase Splitting

- Apply liquid gasket [A] to the mating surface of the lower crankcase half.

**NOTE**

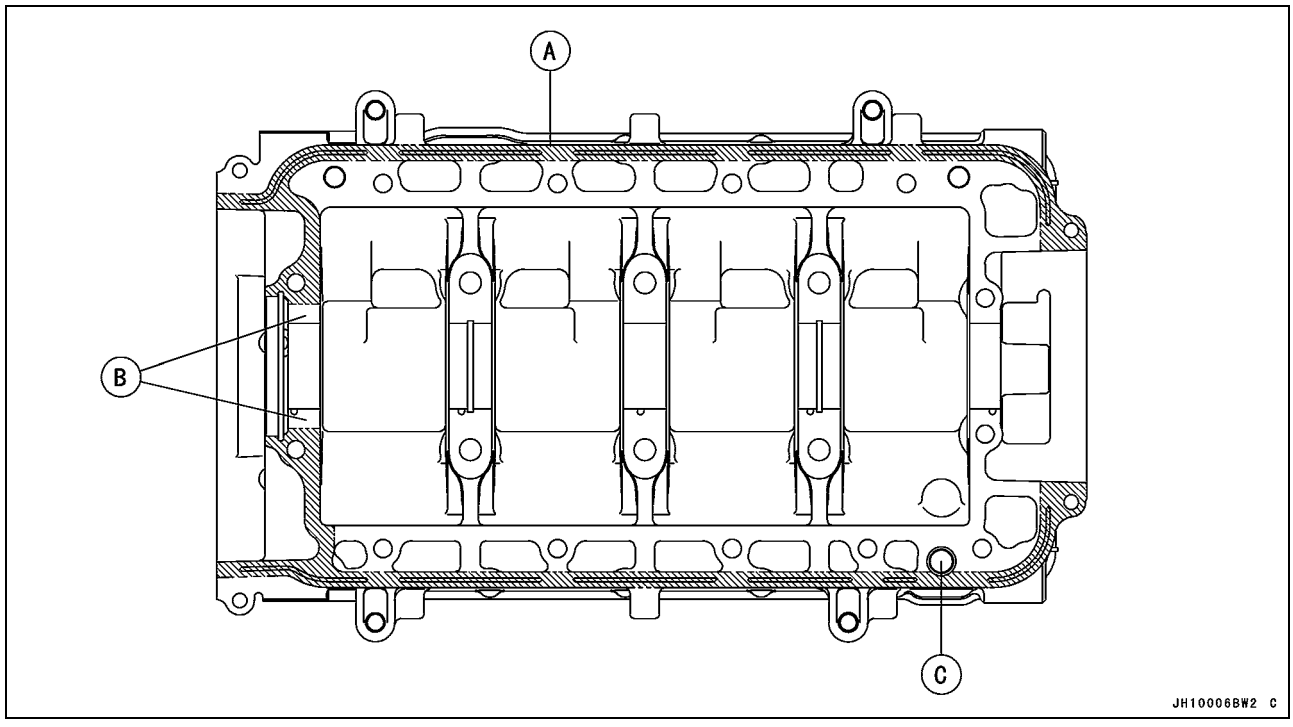
○*Make the application finish within 30 minutes when the liquid gasket to the mating surface of the lower crankcase half is applied.*

○*Moreover fit the case and tighten the case bolts just after finishing the application of the liquid gasket.*

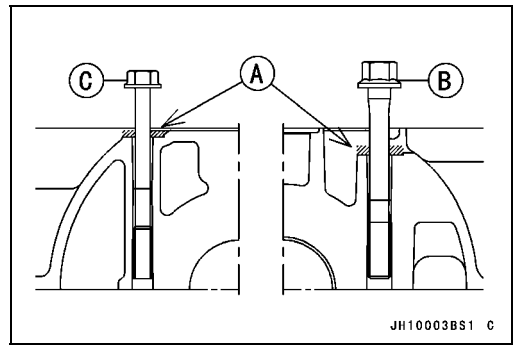
**Sealant - Liquid Gasket, TB1215: 92104-1065**

***NOTICE***

**Do not apply liquid gasket around the crankshaft main bearing inserts [B], and oil passage hole [C].**




- Apply molybdenum disulfide oil solution to the bolt seating surfaces [A] on the lower crankcase for the M10 bolts [B] and M8 [7 ~ 10] bolts [C].



## Crankcase Splitting

● Tighten the crankcase bolts.

○Following the sequence numbers on the lower crankcase half, tighten the M10 bolts [1 ~ 6].

**Torque - Crankcase Bolts (M10): 50 N·m (5.1 kgf·m, 37 ft·lb)**

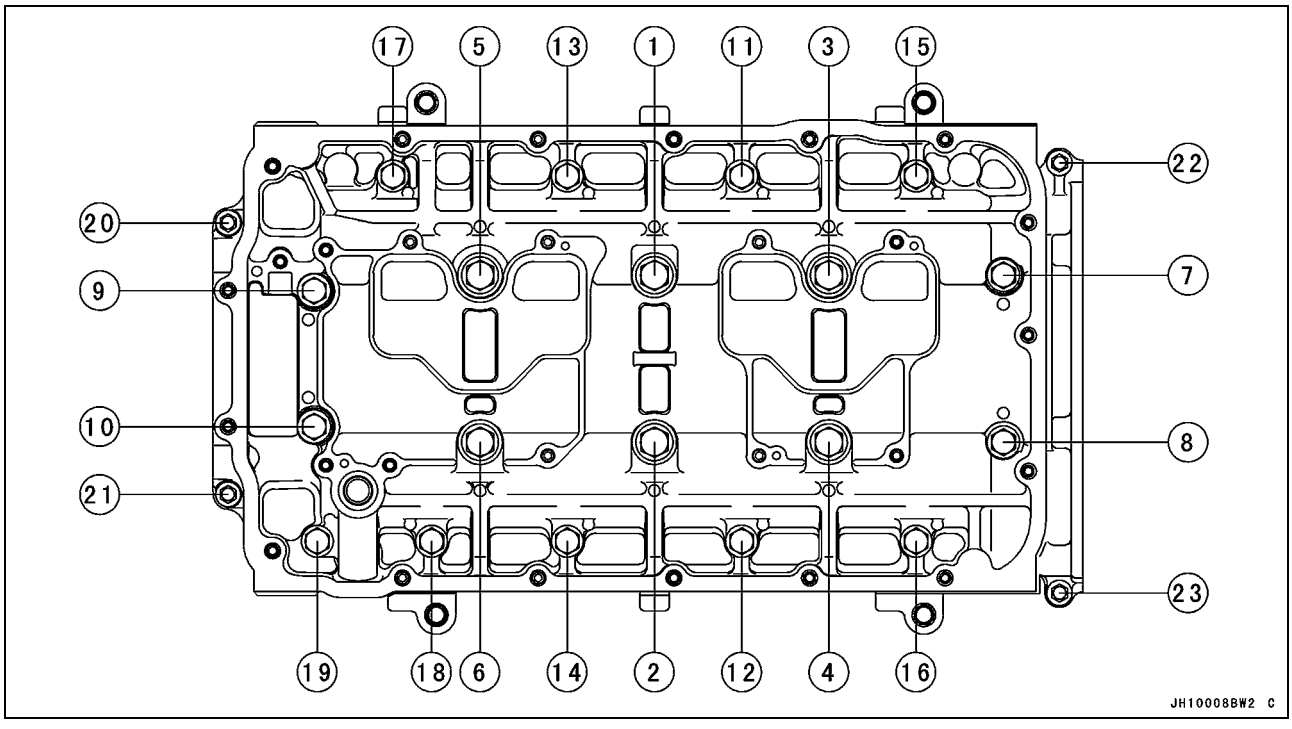
○Following the sequence numbers, tighten the M8 bolts [7 ~ 19].

[7 ~ 10]: L = 85 mm (3.3 in.)
[11 ~ 18]: L = 45 mm (1.8 in.)
[19]: L = 55 mm (2.2 in.)

**Torque - Crankcase Bolts (M8): 30 N·m (3.1 kgf·m, 22 ft·lb)**

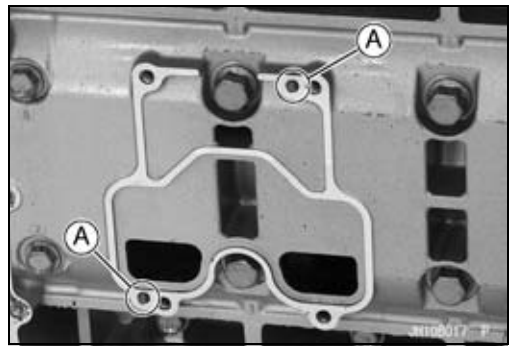
○Following the sequence numbers, tighten the M6 bolts [20 ~ 23].

**Torque - Crankcase Bolts (M6): 12 N·m (1.2 kgf·m, 106 in·lb)**




● After tightening all crankcase bolts, check that the crankshaft turn freely.

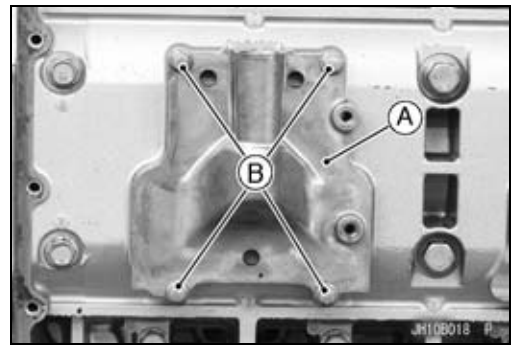
● Install the dowel pins [A].



## Crankcase Splitting

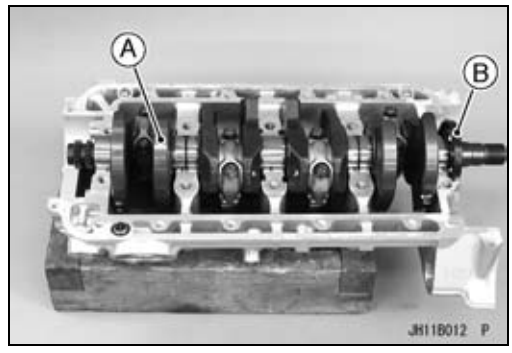
- Install the oil catch cover [A].
- Tighten:

**Torque - Oil Catch Cover Bolts [B]: 7.8 N·m (0.80 kgf·m, 69 in·lb)**



## Crankshaft and Connecting Rods

### *Crankshaft Removal*

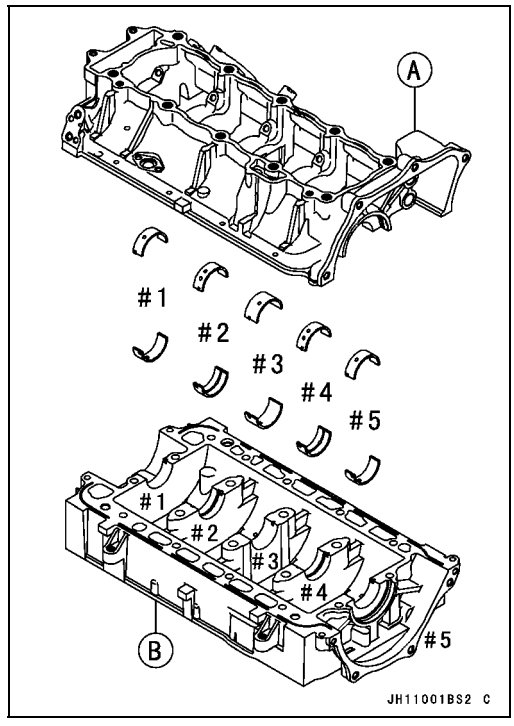



- Split the crankcase (see Crankcase Splitting).
- Remove the crankshaft [A] with the oil seal [B].

### *Crankshaft Installation*

***NOTICE***

**If the crankshaft, bearing inserts, or crankcase halves are replaced with new ones, select the bearing inserts and check clearance with a plastigage before assembling engine to be sure the correct bearing inserts are installed.**

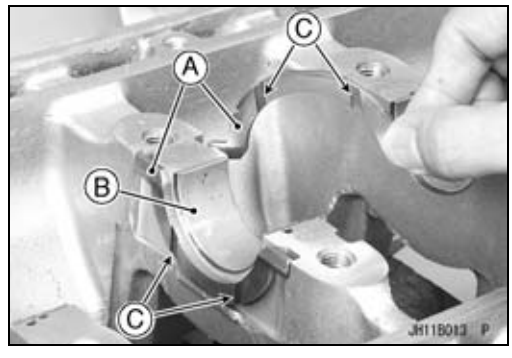



- Fit the crankshaft main bearing inserts on the upper [A] and lower [B] crankcase halves.
  #1, 5 Bearing Inserts (no Groove, same part)
  #2, 4 Bearing Inserts (Groove, same part)
  #3 Bearing Insert (no Groove)

**NOTE**

○*Be sure the bearing inserts are seated in the saddles, and the tangs in the bearing inserts are aligned with the notches in the saddles.*

- Apply molybdenum disulfide oil solution to the crankshaft main bearing inserts.

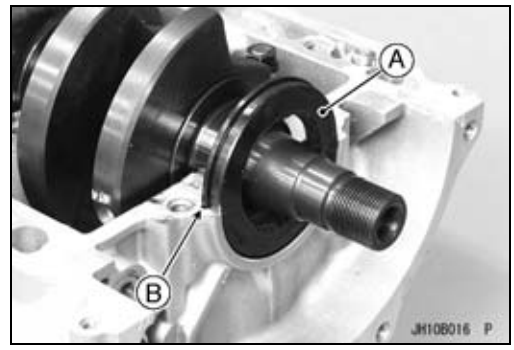



- Fit the thrust washers [A] to both sides of the upper crankcase #3 main bearing [B].

○Install the thrust washer so that the oil grooves [C] face outward.

## Crankshaft and Connecting Rods

- Fit the oil seal [A] into the groove [B] of the crankcase.
- Assemble the crankcase (see Crankcase Assembly).

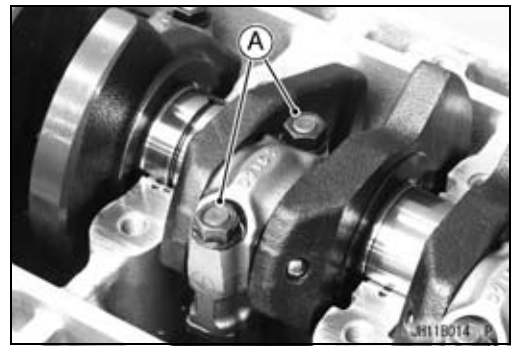



### *Connecting Rod Removal*

- Split the crankcase (see Crankcase Splitting).
- Remove the connecting rod nuts [A].
- Remove the crankshaft.

**NOTE**

○*Mark and record the locations of the connecting rods and their big end caps so that they can be reassembled in their original positions.*




- Remove the connecting rods from the crankshaft.

### *Connecting Rod Installation*

**⚠ WARNING**

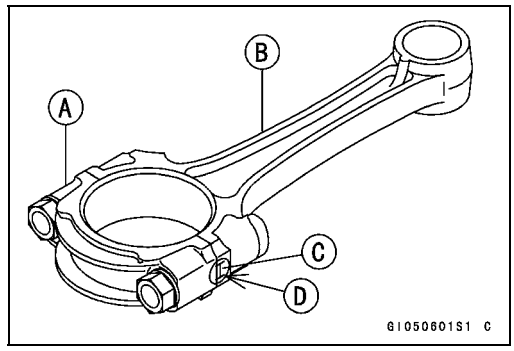
**Gasoline and low flash-point solvents are extremely flammable and can be explosive under certain conditions. To prevent a fire or explosion, clean the crankshaft, bolts, nuts and connecting rods in a well-ventilated area with a high flash-point solvent away from any ignition sources, including any appliance with a pilot light.**

- After removing the connecting rods from the crankshaft, clean them with high flash-point solvent.
- Blow the crankshaft oil passages with compressed air to remove any foreign particles or residue that may have accumulated in the passages.

## Crankshaft and Connecting Rods

**NOTICE**

**Using connecting rods with different weight marks increases engine vibration. To minimize vibration, the connecting rods should have the same weight mark.**



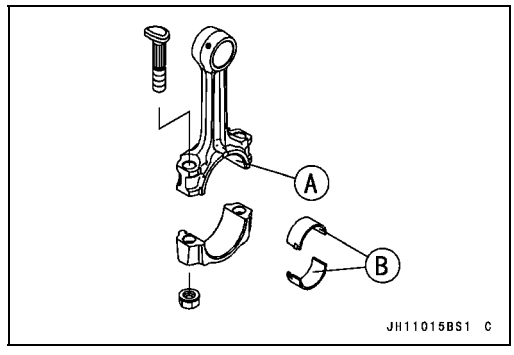

Big End Cap [A]
Connecting Rod [B]
Weight Mark, Alphabet [C]
Diameter Mark [D]

★If the connecting rods, big end bearing inserts, or crankshaft are replaced with new ones, select the bearing insert and check clearance with a plastigage before assembling engine to be sure the correct bearing inserts are installed.

**NOTICE**

**Connecting rod bolts are designed to stretch when tightened; reusing them can lead to catastrophic engine failure. Never reuse connecting rod bolts. See the table below for correct bolt and nut usage.**

- Apply molybdenum disulfide grease to the connecting rod upper bearing [A].
- Apply molybdenum disulfide oil solution to the inner surfaces [B] of the bearing inserts.

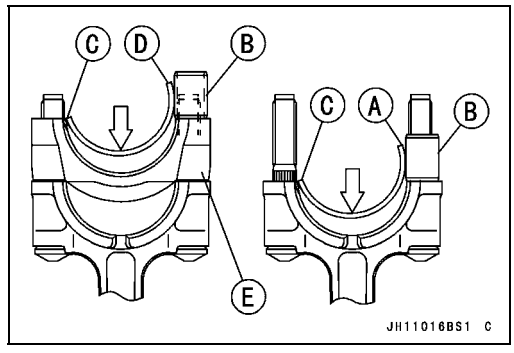



**NOTICE**

**Do not apply grease to the inner surface of the lower big end cap or to the outer surface of the lower bearing insert.**

- Install the bearing insert as shown to prevent its outer surface from scratch damage with connecting rod edge.

Connecting Rod Side Bearing Insert [A]
Dowel Pin [B]
Claw Side [C]
Cap Side Bearing Insert [D]
Connecting Rod Cap [E]




- Replace the connecting rod big end bolts and nuts with new ones.
- Be sure to clean the bolts, nuts, and connecting rods thoroughly with high flash-point solvent, because the new connecting rods, bolts, and nuts are treated with anti-rust solution.

**NOTICE**

**Immediately dry the bolts and nuts with compressed air after cleaning.**
**Clean and dry the bolts and nuts completely.**

## Crankshaft and Connecting Rods

- Install the crankshaft (see Crankshaft Installation).
- Install each connecting rod on its original crankpin.

○Install the cap on the connecting rod, aligning the weight and diameter marks.

○The connecting rod big end is bolted using the “plastic region fastening method”.

○This method precisely achieves the needed clamping force without exceeding it unnecessarily, allowing the use of thinner, lighter bolts further decreasing connecting rod weight.

○There are two types of the plastic region fastening. One is a bolt length measurement method and other is a rotation angle method. Observe one of the following two, but the bolt length measurement method is preferable because this is a more reliable way to tighten the big end nuts.

***NOTICE***

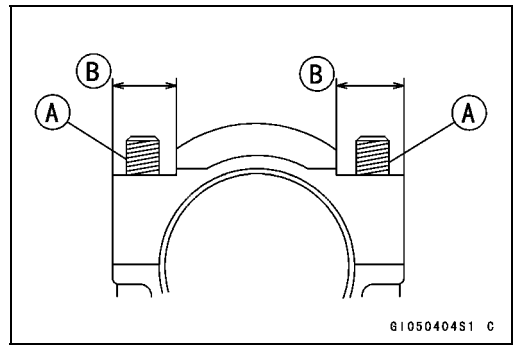
**Connecting rod bolts are designed to stretch when tightened; reusing them can lead to catastrophic engine failure. Never reuse connecting rod bolts. See the table below for correct bolt and nut usage.**

***NOTICE***

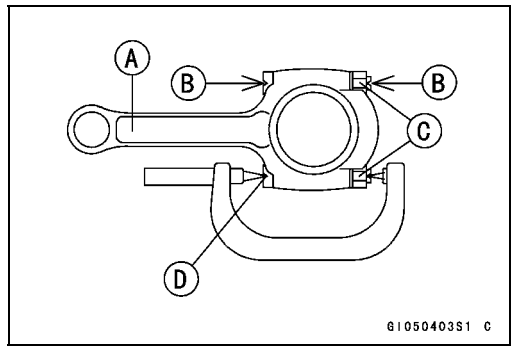
**Be careful not to overtighten the nuts.**
**The bolts must be positioned on the seating surface correctly to prevent the bolt heads from hitting the crankcase.**

(1) Bolt Length Measurement Method

- Install new bolts and nuts in reused connecting rods.
- Dent both bolt head and bolt tip with a punch.
- Apply molybdenum disulfide oil solution to the threads [A] and seating surfaces [B] of the connecting rod nuts.



## Crankshaft and Connecting Rods




- Before tightening, use a point micrometer to measure the length of new connecting rod bolts and record the values to find the bolt stretch.
  Connecting Rod [A]
  Dent here with a punch [B].
  Nuts [C]
  Fit micrometer pins into dents [D].
- Apply a small amount of molybdenum disulfide oil solution to the following.
  Threads of Nuts and Bolts
  Seating Surfaces of Nuts and Connecting Rods
- Tighten the big end nuts until the bolt elongation reaches the length specified in the table.
- Check the length of the connecting rod bolts.

★If the stretch is more than the usable range, the bolt has stretched too much. An overelongated bolt may break in use.

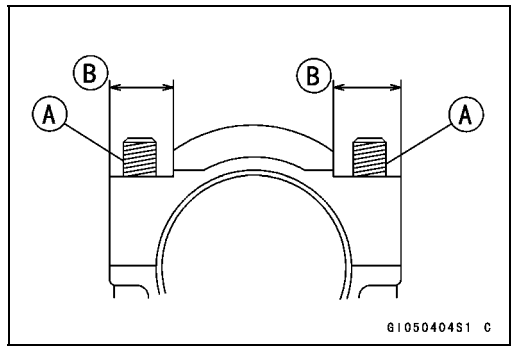
Bolt Length after tightening – Bolt Length before tightening = Bolt Stretch

| Connecting Rod Assy | Bolt | Nut | Usable Range of Connecting Rod Bolt Stretch |
|---|---|---|---|
| New | Use the bolts attached to new con-rod. | Attached to new con-rod | 0.20 ~ 0.29 mm (0.0079 ~ 0.0114 in.) |
| | New | New | |
| Used | Replace the bolts with new ones. | Replace the nuts with new ones. | 0.20 ~ 0.29 mm (0.0079 ~ 0.0114 in.) |

(2) Rotation Angle Method

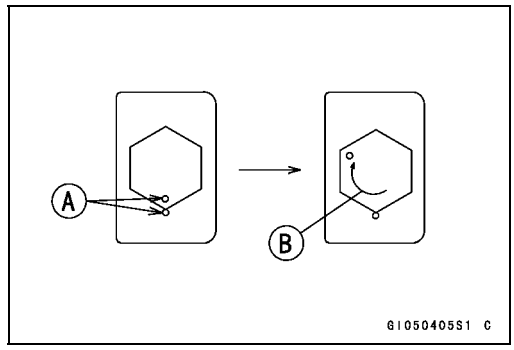
★If you don't have a point micrometer, you may tighten the nuts using the "Rotation Angle Method".

- Install new bolts and nuts in reused connecting rod.
- Apply molybdenum disulfide oil solution to the threads [A] and seating surfaces [B] of the connecting rod nuts.




- First, tighten the nuts to the specified torque. See the table below.
- Next, tighten the nuts **120° ± 5°**.

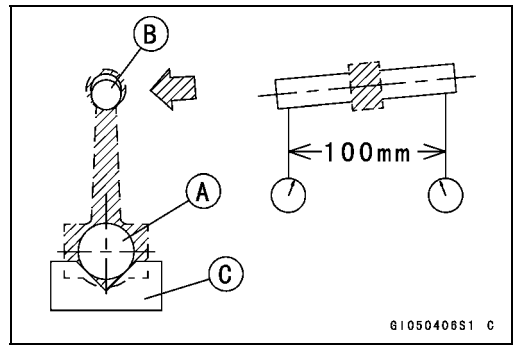
○Mark [A] the connecting rod big end caps and nuts so that nuts can be turned 120° [B] properly.




| Connecting Rod Assy | Bolt | Nut | Torque + Angle N·m (kgf·m, ft·lb) |
|---|---|---|---|
| New | Use the bolts attached to new con-rod. | Attached to new con-rod | 18 (1.8, 13) + 120° |
| | New | New | 18 (1.8, 13) + 120° |
| Used | Replace the bolts with new ones | Replace the nuts with new ones | 18 (1.8, 13) + 120° |

## Crankshaft and Connecting Rods

### *Connecting Rod Bend Inspection*

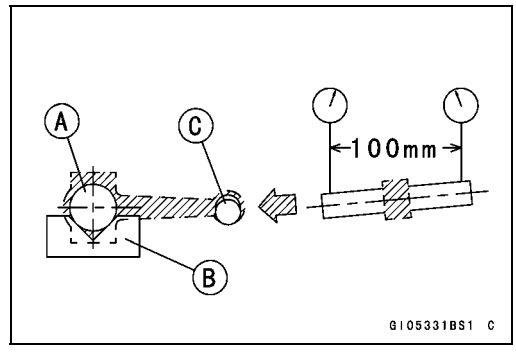



- Remove the connecting rod big end bearing inserts, and reinstall the connecting rod big end caps.
- Select an arbor [A] of the same diameter as the connecting rod big end, and insert the arbor through the connecting rod big end.
- Select an arbor of the same diameter as the piston pin at least 100 mm (3.94 in.) long, and insert the arbor [B] through the connecting rod small end.
- On a surface plate, set the big-end arbor on V blocks [C].
- Measure the difference in the heights of the arbor above the surface plate over a 100 mm (3.94 in.) distance-on the arbor to determine the amount of connecting rod bend with the connecting rod held vertically, and using a height gauge.

★If connecting rod bend exceeds the service limit, the connecting rod must be replaced.

**Connecting Rod Bend**
**Service Limit: 0.2/100 mm (0.008/3.94 in.)**

### *Connecting Rod Twist Inspection*

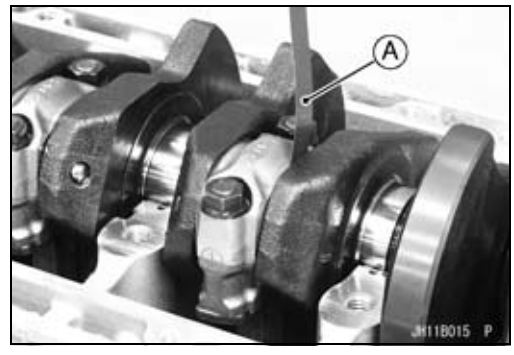



- On surface plate, set the big-end arbor [A] on V block [B].
- Measure the difference in the heights of the arbor [C] above the surface plate over a 100 mm (3.94 in.) distance-on the arbor to determine the amount of connecting rod twist with the connecting rod held horizontally, and using a height gauge.

★If connecting rod twist exceeds the service limit, the connecting rod must be replaced.

**Connecting Rod Twist**
**Service Limit: 0.2/100 mm (0.008/3.94 in.)**

### *Connecting Rod Big End Side Clearance*




- Measure connecting rod big end side clearance.

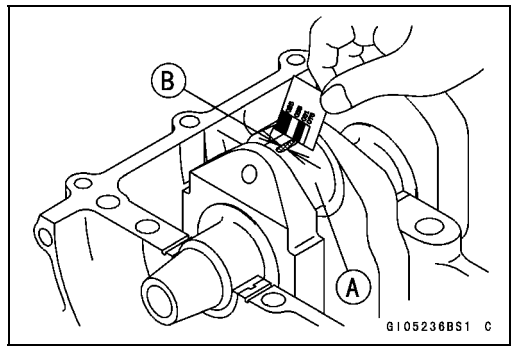
○Insert a thickness gauge [A] between the big end and either crank web to determine clearance.

**Connecting Rod Big End Side Clearance**
**Standard: 0.13 ~ 0.38 mm (0.0051 ~ 0.0150 in.)**
**Service Limit: 0.6 mm (0.024 in.)**

★If the clearance exceeds the service limit, replace the connecting rod with a new one and then check clearance again. If clearance is too large after connecting rod replacement, the crankshaft also must be replaced.

## Crankshaft and Connecting Rods

### *Connecting Rod Big End Bearing Insert/Crankpin Wear Inspection*




- Measure the bearing insert/crankpin [A] clearance with a plastigage [B].

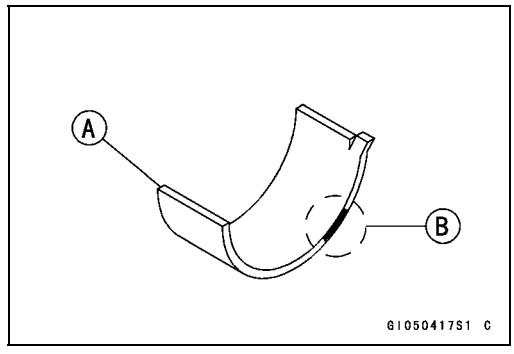
**NOTE**

○*Tighten the connecting rod big end nuts to the specified torque (see Connecting Rod Installation).*
○*Do not move the connecting rod and crankshaft during clearance measurement.*

**Connecting Rod Big End Bearing Insert/Crankpin Clearance**

**Standard: 0.041 ~ 0.071 mm (0.0016 ~ 0.0028 in.)**

**Service Limit: 0.11 mm (0.0043 in.)**




★If clearance is within the standard, no bearing replacement is required.
★If clearance is between 0.072 mm (0.00284 in.) and the service limit 0.11 mm (0.0043 in.), replace the bearing inserts [A] with inserts painted green [B]. Check insert/crankpin clearance with the plastigage. The clearance may exceed the standard slightly, but it must not be less than the minimum in order to avoid bearing seizure.
★If the clearance exceeds the service limit, measure the diameter of the crankpins.

**Crankpin Diameter**

**Standard: 38.984 ~ 39.000 mm (1.53480 ~ 1.53543 in.)**

**Service Limit: 38.97 mm (1.5342 in.)**

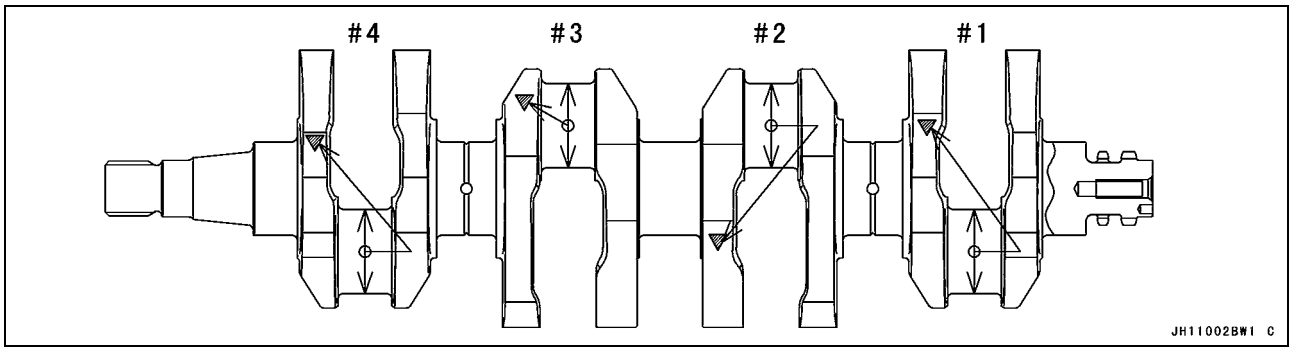
★If any crankpin has worn past the service limit, replace the crankshaft with a new one.
★If the measured crankpin diameters are not less than the service limit, but do not coincide with the original diameter markings on the crankshaft, make new marks on it.

**Crankpin Diameter Marks**

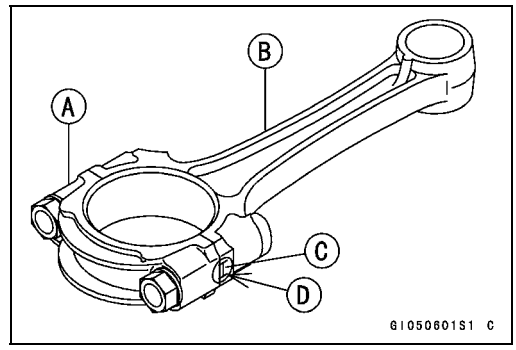
**None 38.984 ~ 38.992 mm (1.53480 ~ 1.53512 in.)**

**○ 38.993 ~ 39.000 mm (1.53515 ~ 1.53543 in.)**

Δ: Crankpin Diameter Marks, "○" mark or no mark.



## Crankshaft and Connecting Rods




- Measure the connecting rod big end inside diameter, and mark each connecting rod big end in accordance with the inside diameter.
  Big End Cap [A]
  Connecting Rod [B]
  Weight Mark [C]: A letter of the alphabet
  Inside Diameter Mark (Around Weight Mark) [D]: "○" or no mark.

**NOTE**

○*Tighten the connecting rod big end nuts to the specified torque (see Connecting Rod Installation).*
○*The mark already on the big end should almost coincide with the measurement.*

**Connecting Rod Big End Inside Diameter Marks**

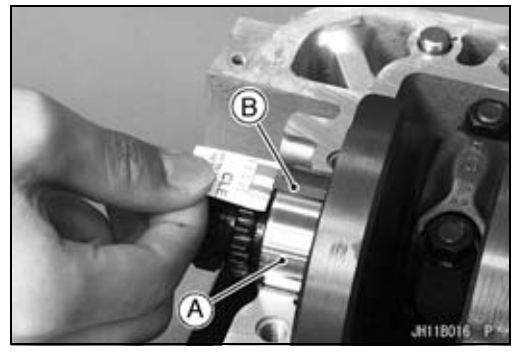
**None 42.000 ~ 42.008 mm (1.65354 ~ 1.65385 in.)**

**○ 42.009 ~ 42.016 mm (1.65389 ~ 1.65417 in.)**

- Select the proper bearing insert in accordance with the combination coding of the connecting rod and crankshaft.
- Install the new inserts in the connecting rod and check insert/crankpin clearance with the plastigage.

| Connecting Rod Big End Inside Diameter Marking | Crankpin Diameter Marking | Bearing Insert | |
|---|---|---|---|
| | | Size Color | Part Number |
| None | ○ | Pink | 92139-0724 |
| None | None | Yellow | 92139-0723 |
| ○ | ○ | | |
| ○ | None | Green | 92139-0722 |

### *Crankshaft Main Bearing Insert/Journal Wear Inspection*




- Measure the bearing insert/journal [A] clearance with a plastigage [B].

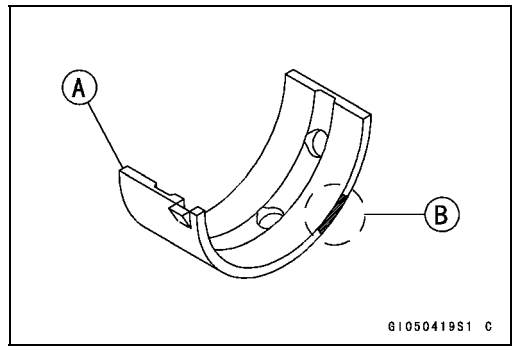
**NOTE**

○*Tighten the crankcase bolts to the specified torque (see Crankcase Assembly).*
○*Do not turn the crankshaft during clearance measurement.*
○*Journal clearance less than 0.025 mm (0.0010 in.) can not be measured by plastigage, however, using genuine parts maintains the minimum standard clearance.*

## Crankshaft and Connecting Rods

**Crankshaft Main Bearing Insert/Journal Clearance**
**Standard: 0.030 ~ 0.054 mm (0.0012 ~ 0.0021 in.)**
**Service Limit: 0.08 mm (0.0031 in.)**

★If clearance is within the standard, no bearing replacement is required.
★If clearance is between 0.055 mm (0.022 in.) and the service limit 0.08 mm (0.0031 in.), replace the bearing inserts [A] with inserts painted green [B]. Check insert/journal clearance with the plastigage. The clearance may exceed the standard slightly, but it must not be less than the minimum in order to avoid bearing seizure.
★If clearance exceeds the service limit, measure the diameter of the crankshaft main journal.



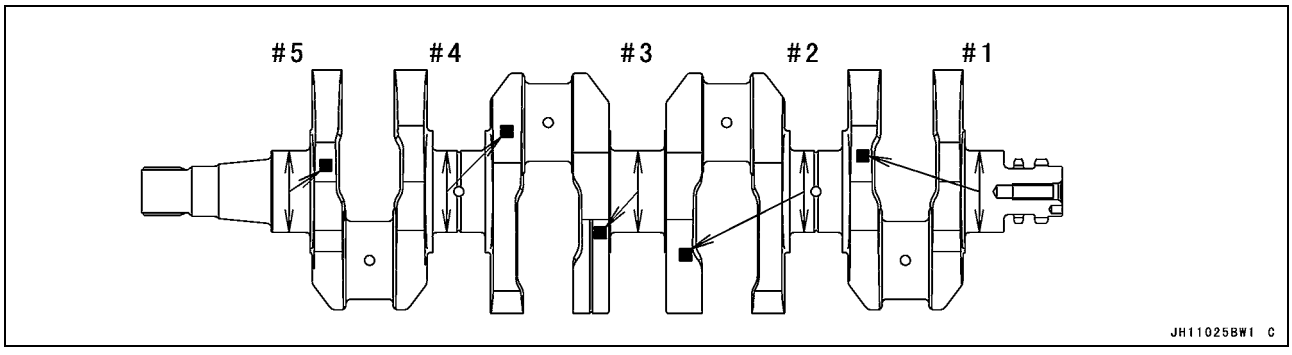

**Crankshaft Main Journal Diameter**
**Standard: 40.984 ~ 41.000 mm (1.61354 ~ 1.61417 in.)**
**Service Limit: 40.96 mm (1.6126 in.)**

★If any journal has worn past the service limit, replace the crankshaft with a new one.
★If the measured journal diameters are not less than the service limit, but do not coincide with the original diameter markings on the crankshaft, make new marks on it.

**Crankshaft Main Journal Diameter Marks**

| | |
|---|---|
| **None** | **40.984 ~ 40.992 mm (1.61354 ~ 1.61386 in.)** |
| **1** | **40.993 ~ 41.000 mm (1.61389 ~ 1.61417 in.)** |

■: Crankshaft Main Journal Diameter Marks, “1” mark or no mark.



## Crankshaft and Connecting Rods

● Measure the main bearing inside diameter, and mark [A] the upper crankcase half [B] in accordance with the inside diameter.

○Crankcase main bearing inside diameter marks are "○" mark and no mark.

**NOTE**

○*Tighten the crankcase bolts to the specified torque (see Crankcase Assembly).*

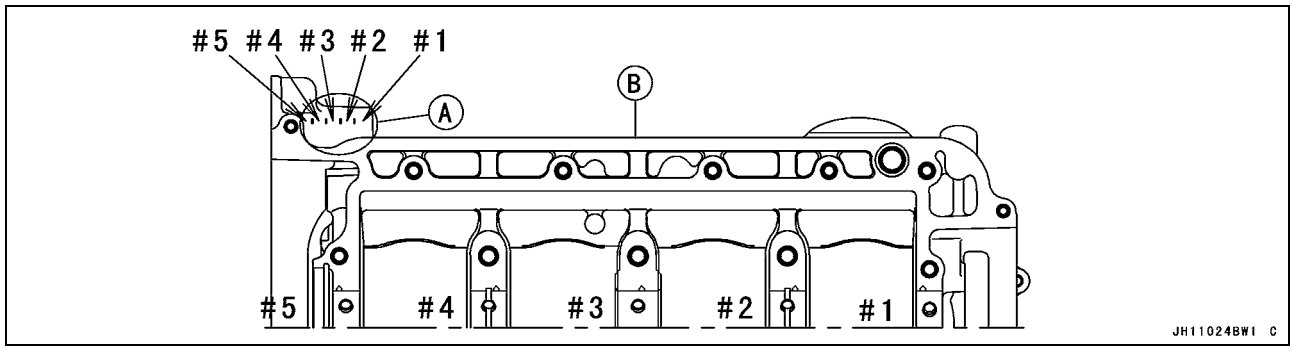
○*The mark already on the upper crankcase half should almost coincide with the measurement.*

**Crankcase Main Bearing Inside Diameter Marks**

**○ 44.000 ~ 44.008 mm (1.73228 ~ 1.73259 in.)**

**None 44.009 ~ 44.016 mm (1.73263 ~ 1.73290 in.)**

### Marking Position




● Select the proper bearing insert in accordance with the combination coding of the crankcase and crankshaft.

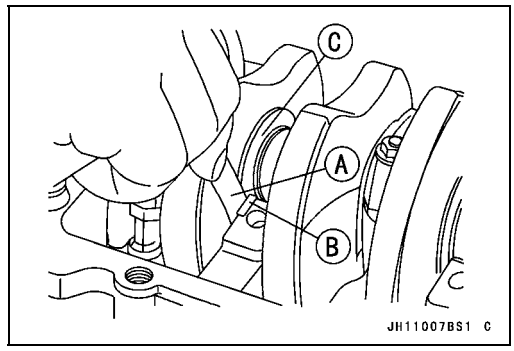
● Install the new inserts in the crankcase halves and check insert/journal clearance with the plastigage.

| Crankcase Main Bearing Inside Diameter Marking | Crankshaft Main Journal Diameter Marking | Bearing Insert* | | |
|---|---|---|---|---|
| | | Size Color | Part Number | Journal No. |
| ○ | 1 | Pink | 92139-0727 | 1, 5 |
| | | | 92139-0730 | 2, 4 |
| | | | 92139-0733 | 3 |
| ○ | None | Yellow | 92139-0726 | 1, 5 |
| | | | 92139-0729 | 2, 4 |
| None | 1 | | 92139-0732 | 3 |
| None | None | Green | 92139-0725 | 1, 5 |
| | | | 92139-0728 | 2, 4 |
| | | | 92139-0731 | 3 |

*The bearing inserts for Nos. 2 and 4 journals have an oil groove, respectively.

## Crankshaft and Connecting Rods

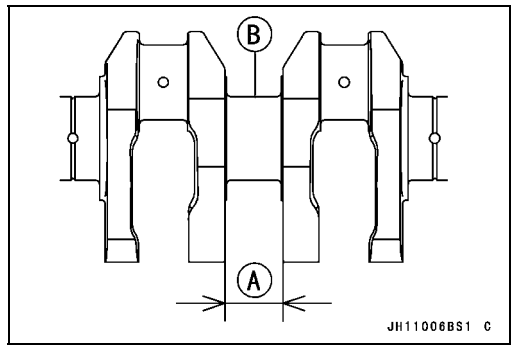
### *Crankshaft Side Clearance Inspection*




- Insert a thickness gauge [A] between the thrust washer [B] and the crank web [C] at the No. 3 main journal to determine clearance.

★If the clearance exceeds the service limit, replace the thrust washer as a set and check the width of the crankshaft #3 main journal.

**Crankshaft Side Clearance**
**Standard: 0.05 ~ 0.24 mm (0.0020 ~ 0.0094 in.)**
**Service Limit: 0.44 mm (0.017 in.)**




- Measure the crankshaft #3 main journal width [A].

★If the measurement exceeds the standard, replace the crankshaft [B].

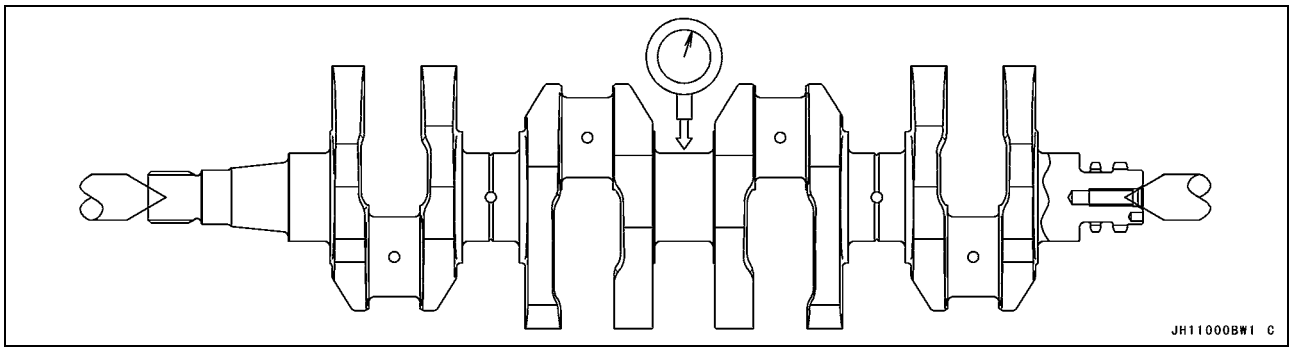
**Crankshaft #3 Main Journal Width**
**Standard: 27.45 ~ 27.55 mm (1.081 ~ 1.085 in.)**

### *Crankshaft Runout Inspection*

- Measure the crankshaft runout.

★If the measurement exceeds the service limit, replace the crankshaft.

**Crankshaft Runout**
**Standard: TIR 0.03 mm (0.0012 in.) or less**
**Service Limit: TIR 0.07 mm (0.0028 in.)**



# Cooling and Bilge Systems

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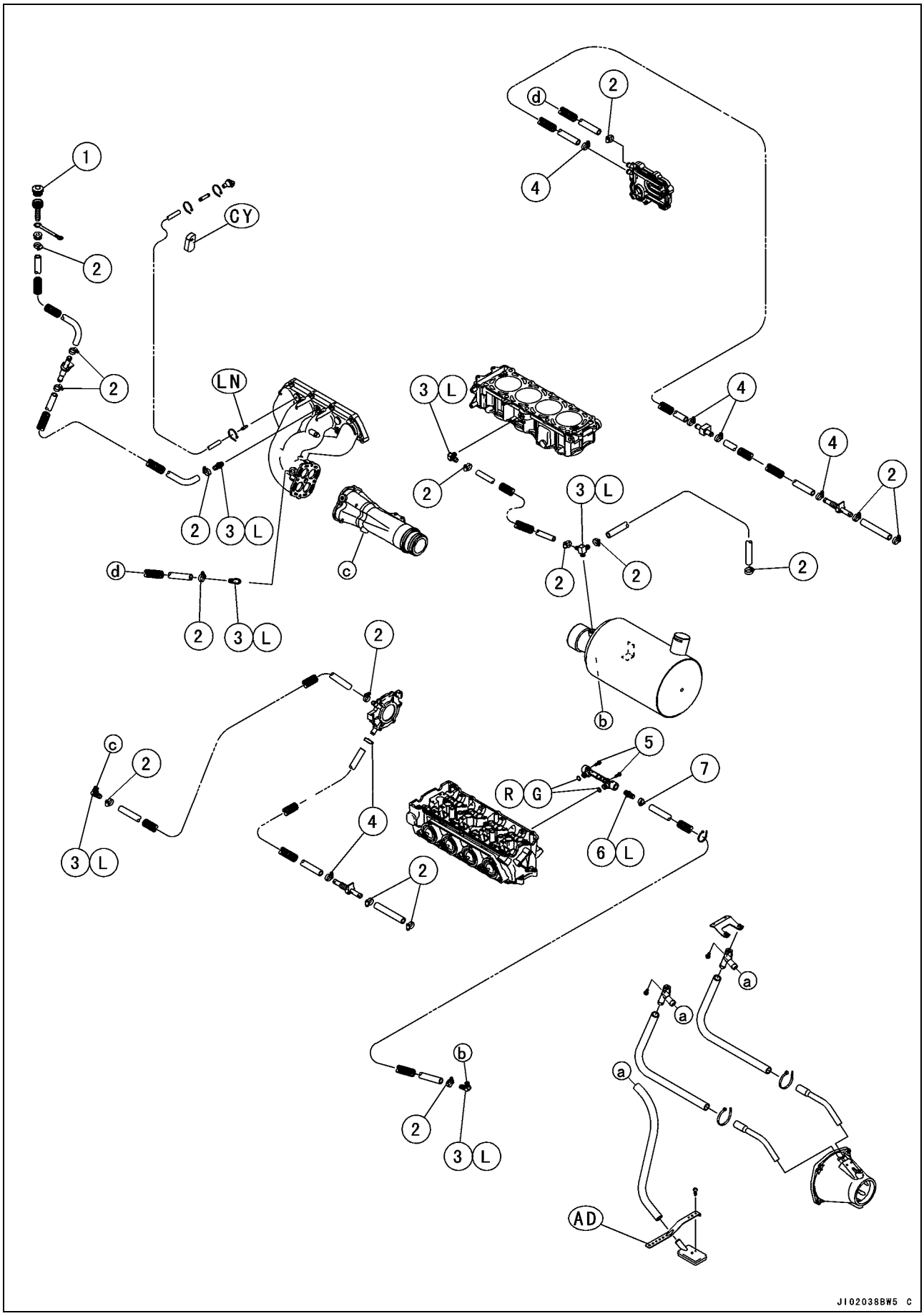
## Exploded View



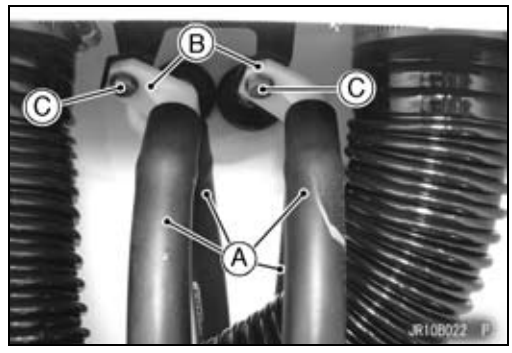
## Exploded View

| No. | Fastener | Torque | | | Remarks |
|---|---|---|---|---|---|
| | | N·m | kgf·m | ft·lb | |
| 1 | Flushing Cap | 0.90 | 0.092 | 8.0 in·lb | |
| 2 | Water Hose Clamp Screws | 2.5 | 0.25 | 22 in·lb | |
| 3 | Water Hose Joints | 11 | 1.1 | 97 in·lb | L |
| 4 | Water Hose Clamp Screws | 4.0 | 0.41 | 35 in·lb | |
| 5 | Water Pipe Mounting Bolts | 7.8 | 0.80 | 69 in·lb | |
| 6 | Water Hose Joint (Water Pipe) | 20 | 2.0 | 15 | L |
| 7 | Water Hose Clamp Screw | 3.0 | 0.31 | 27 in·lb | |

AD: Apply adhesive.
CY: Apply cyanoacrylate cement.
G: Apply grease.
L: Apply a non-permanent locking agent.
LN: Apply a non-permanent locking agent (High Strength).
R: Replacement Parts

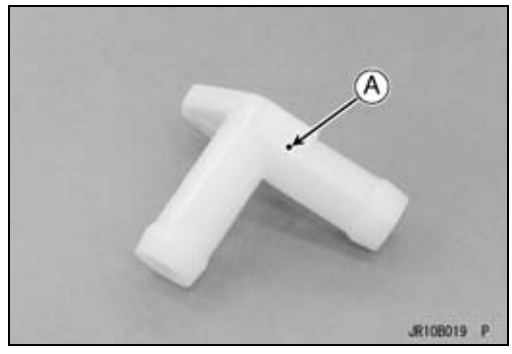
## Bilge System

### *Breather Removal*




- Remove:
  Seats (see Seat Removal in the Hull/Engine Hood chapter)
  Handrail Plate (see Handrail Plate Removal in the Hull/Engine Hood chapter)
- Pull the hoses [A] off the breathers [B].
- Unscrew the mounting bolts [C], and remove the breathers.

### *Breather Installation*



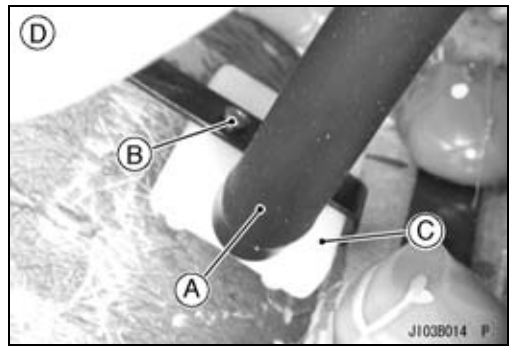

- Be sure the small hole [A] in the breather is open before installing it.
- Tighten the breather mounting bolts.

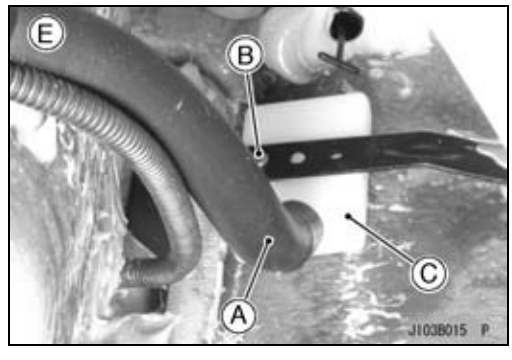
### *Breather Cleaning and Inspection*

- Check that the small hole in the top of the breather is open by blowing in one end of the breather and plugging the other.

★If the hole is plugged, clean it with compressed air. Do not open it with a pointed object (like a needle or a piece of wire), because the hole may be enlarged. If the hole is too large, the bilge system may not suck water out of the hull as it should.

### *Filter Removal*



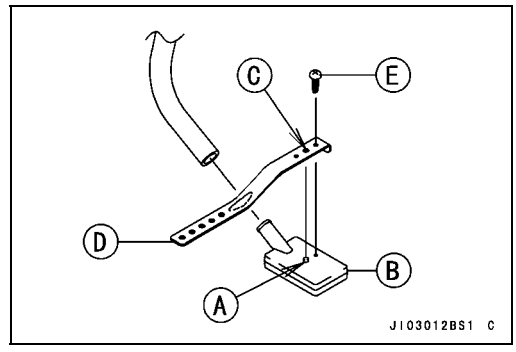




- Remove the engine (see Engine Removal/Installation chapter).
- Pull the hose [A] off the filter.
- Unscrew the mounting screw [B] and remove the filter [C].
  Starboard Side [D]
  Port Side [E]

## Bilge System

### *Filter Installation*

- Align the projection [A] on the filter [B] with the hole [C] on the bracket [D].
- Tighten the filter mounting screw [E].




### *Filter Cleaning and Inspection*

- Flush the filter thoroughly with fresh water and shake it dry.
- Water must flow freely through the filter, but large debris must not.

★If the filter cannot be cleaned, or if it is broken and allows debris to pass through, replace it.

## Cooling and Bilge System Hoses

### *Hose Removal*

- The majority of bilge hoses have no clamps at the hose ends. The majority of bilge system hoses may be simply pulled off their fittings.

**NOTE**

○*Some of the bilge system hoses have plastic clamps at hose ends.*

- All the cooling system hoses are clamped at both ends. Loosen the clamps and pull the hoses off.

### *Hose Installation*

- To install the bilge filter hose, push the hose over the end of the filter.

**NOTE**

○*Some of the bilge system hoses have plastic clamps at hose ends.*

- When installing the cooling system hoses, be sure to use the same kind of clamp as the original. Some of the clamps are metal for tighter clamping ability (required when smooth fittings are used). Plastic clamps are used where tight clamping is not required.

### *Hose Inspection*

- Refer to the Hose and Hose Connect Inspection in the Periodic Maintenance chapter.

## Cooling and Bilge System Flushing

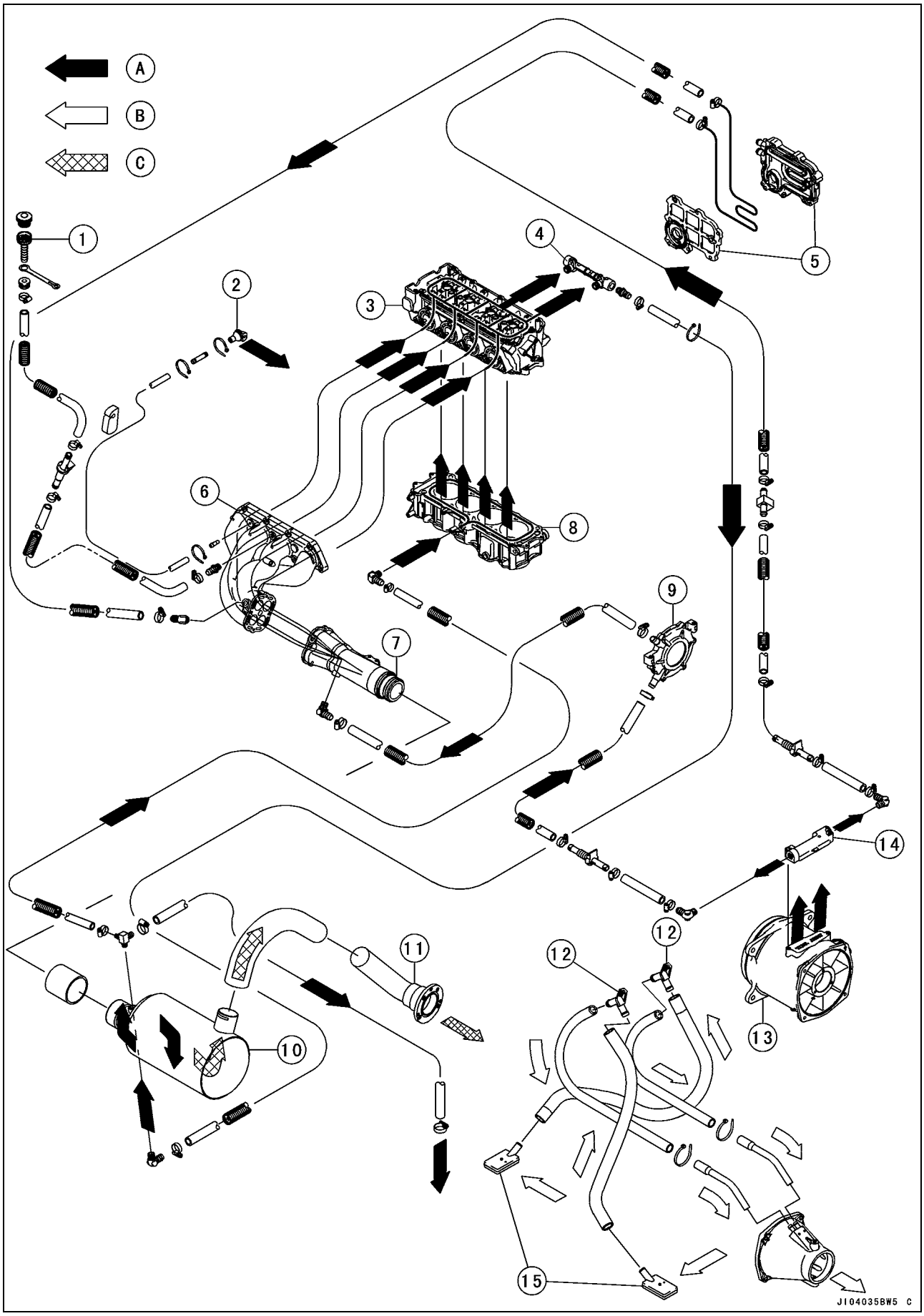
### *Cooling System Flushing*

- Refer to the Cooling System Flushing in the Periodic Maintenance chapter.

### *Bilge System Flushing*

- Refer to the Bilge System Flushing in the Periodic Maintenance chapter.

## Cooling and Bilge System Flow Diagram



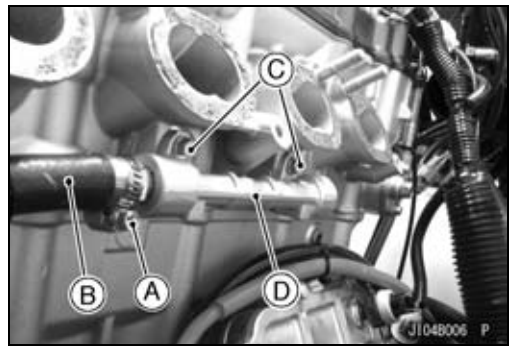
## Cooling and Bilge System Flow Diagram

1. Flushing Fitting
2. Bypass Outlet
3. Cylinder Head
4. Water Pipe
5. Oil Cooler
6. Exhaust Manifold
7. Exhaust Pipe
8. Cylinder
9. Output Cover
10. Water Box Muffler
11. Tail Pipe
12. Bilge Breathers
13. Pump
14. Cooling Water Filter Cover
15. Bilge Filters

A. Direction of Cooling System Flow
B. Direction of Bilge System Flow
C. Direction of Combined Exhaust Gas and Cooling Water Flow

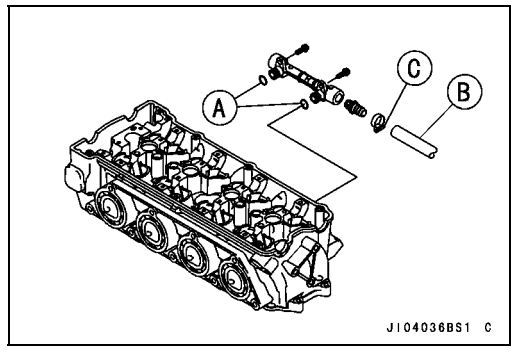
## Water Pipe

### *Water Pipe Removal*




- Remove the intake manifold (see Intake Manifold Removal in the Fuel System (DFI) chapter).
- Loosen the clamp screw [A], and remove the water hose [B].
- Unscrew the mounting bolts [C] and remove the water pipe [D] from the cylinder head.

### *Water Pipe Installation*




- Replace the O-rings [A] with new ones and apply grease to new O-rings.
- Install the O-rings and water pipe.
- Tighten:

**Torque - Water Pipe Mounting Bolts : 7.8 N·m (0.80 kgf·m, 69 in·lb)**

- Install the water hose [B] to the water hose joint.
- Tighten:

**Torque - Water Hose Clamp Screw [C]: 3.0 N·m (0.31 kgf·m, 27 in·lb)**

## After Submerging

***NOTICE***

**If water enters the engine it will cause severe damage. Do not operate the watercraft with water in the engine. Do not try to start the engine until it is completely empty of water. If water gets into the engine, follow this procedure immediately! If water is left in the engine more than a few hours, it will destroy the crankshaft bearings and damage other internal engine parts.**

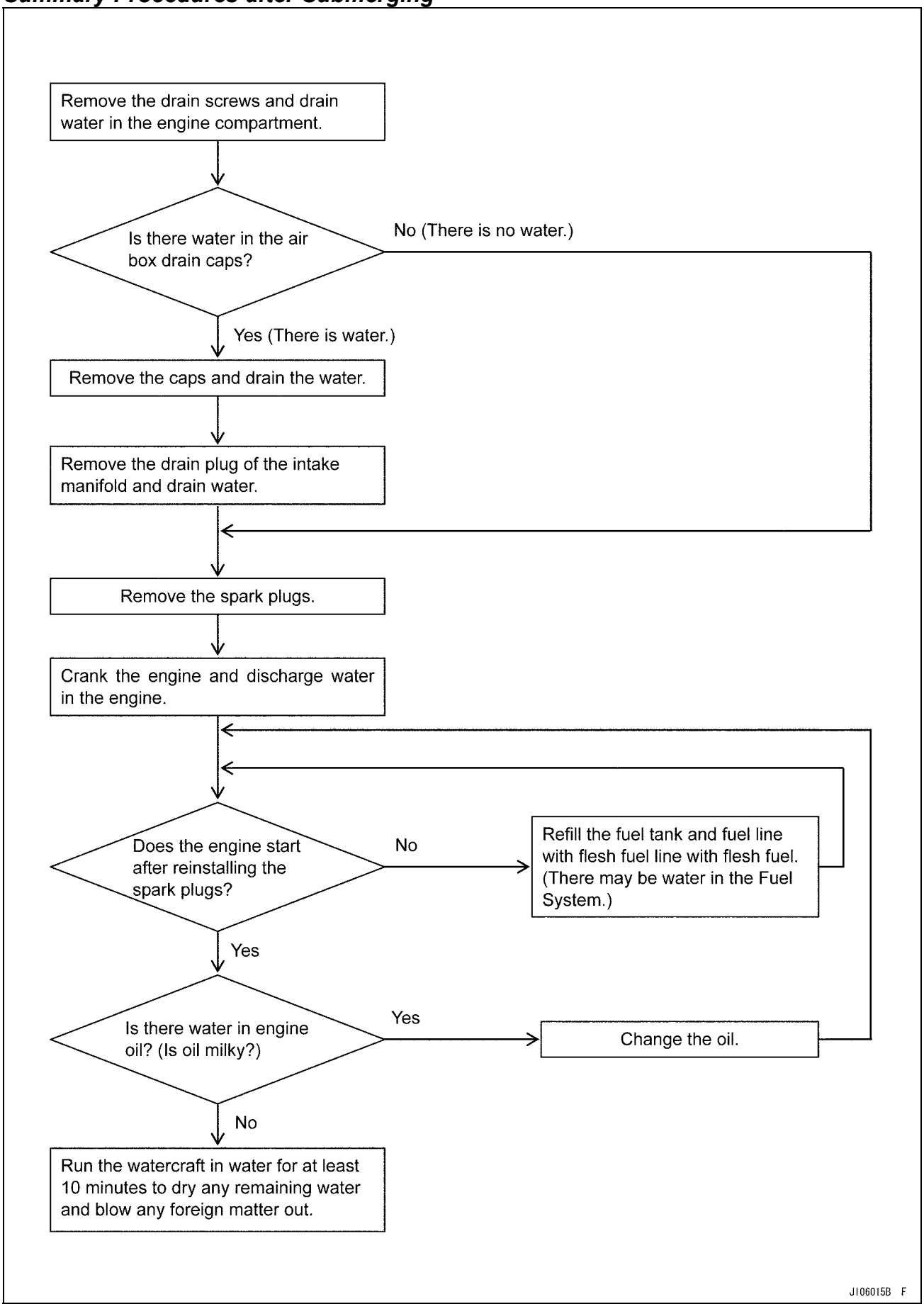
If the watercraft becomes swamped, water may enter the engine through the throttle body assy. Water may also enter the fuel tank.

The following procedures explain the necessary steps you must provide.

Read the summary of the procedure first and then their detailed procedures carefully.

## After Submerging

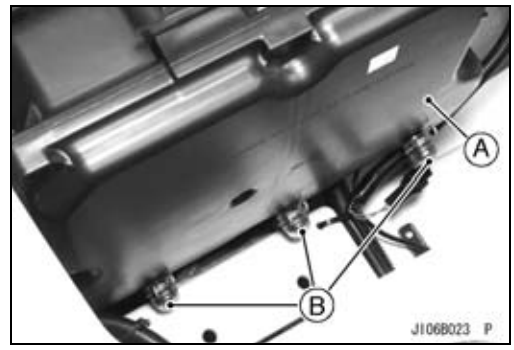
### *Summary Procedures after Submerging*


Remove the drain screws and drain water in the engine compartment.
Is there water in the air box drain caps?
No (There is no water.)
Yes (There is water.)
Remove the caps and drain the water.
Remove the drain plug of the intake manifold and drain water.
Remove the spark plugs.
Crank the engine and discharge water in the engine.
Does the engine start after reinstalling the spark plugs?
No
Refill the fuel tank and fuel line with flesh fuel line with flesh fuel. (There may be water in the Fuel System.)
Yes
Is there water in engine oil? (Is oil milky?)
Yes
Change the oil.
No
Run the watercraft in water for at least 10 minutes to dry any remaining water and blow any foreign matter out.
J106015B F

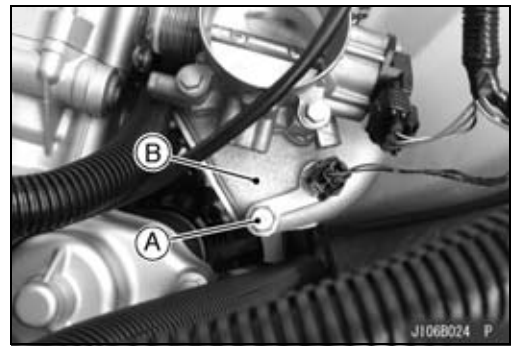
## After Submerging

### *Detailed Procedures after Submerging*

1. Remove the seats (see Seat Removal in the Hull/Engine Hood chapter).
2. Remove the drain screws in the stern to drain water out of the engine compartment.
3. Check the air box [A] for water inside with its drain caps [B].
4. If you see water in the caps, remove the caps and discharge the water. Be sure to have a rag or cloth underneath for possible oily water.




5. Remove the drain plug [A] of the intake manifold [B] and discharge water, if any, into a rag or cloth.



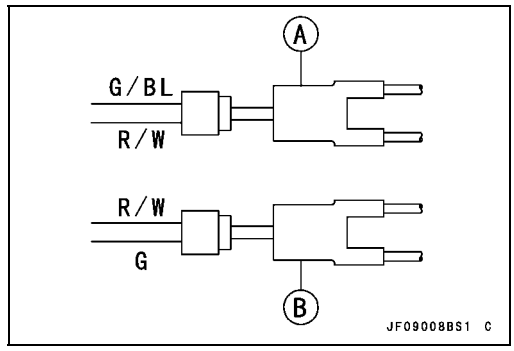

6. Disconnect both two connection on the ignition coil primary lead connectors [A].
7. Pull and remove all the spark plug caps.
8. Remove all spark plugs (see Spark Plug Cleaning and Inspection in the Periodic Maintenance chapter).
9. Insert the ignition key in the ignition switch to turn it on, push the lanyard key under the stop button, and push the start button.
10. If there is any water in the engine, it will be pumped out of the spark plug holes. Do not operate the starter for longer than 5 seconds. Wait 15 seconds before using it again. Be sure that all the water is out of the engine.
11. Spray the spark plugs clean and install them with their plug caps.

**⚠ WARNING**

**A water and gasoline mixture will be forcibly ejected from the spark plug holes and could injure your eyes. To prevent eye injury, do not lean over the engine when performing this procedure. If gas does get in your eyes, immediately wash them with plenty of clean, fresh water and consult a physician as soon as possible.**

## After Submerging

12. Reconnect the ignition coil primary lead connectors, noting the #1, #4 [A] and the #2, #3 [B] coil connectors. The #1, #4 coil connector has a red/white and a green/blue leads from the main harness. The #2, #3 coil connector has a red/white and green leads from the main harness.




**NOTE**

○ *The service codes (51 and 52) caused by this procedure are stored in the ECU.*

13. Start the engine by pressing the start button and run less than 15 seconds.

***NOTICE***

**Running the engine with the watercraft out of the water for more than 15 seconds at a time will cause overheating resulting in engine and exhaust system damage. To prevent engine and exhaust system damage, do not run the engine with the watercraft out of the water for more than 15 seconds at a time. Never operate the engine at maximum speed out of the water.**

14. If the engine does not start, there may be water in the fuel system.
15. If the fuel tank has water in it, it must be emptied by pump or siphon. Refill the tank with fresh fuel. Do not dump contaminated fuel in places not designated for that purpose.
16. Continued trouble may require cleaning of the fuel line to drain water.
17. Remove the dipstick and check for the water presence in the engine oil (If there is water in it, oil looks milky.).
18. If the oil looks milky, then change the oil and repeat procedures 13 and 17 until the oil does not turn milky any more.

**⚠ WARNING**

**Gasoline is extremely flammable and can be explosive under certain conditions. To avoid a possible fire or explosion, pull the lanyard key off the stop button. Do not smoke. Make sure the area is well ventilated and free from any source of flame or sparks; this includes any appliance with a pilot light.**

**⚠ WARNING**

**Gasoline is toxic and pollutes the environment. To protect the environment, do not discard gasoline; always return it to an authorized recycling center.**

19. Reinstall the seat and secure it.
20. Reinstall the drain screws in the stern.
21. Finally, run the watercraft IN WATER for at least 10 minutes to dry any remaining water and blow any foreign matter (like salt) out through the exhaust.

# Drive System

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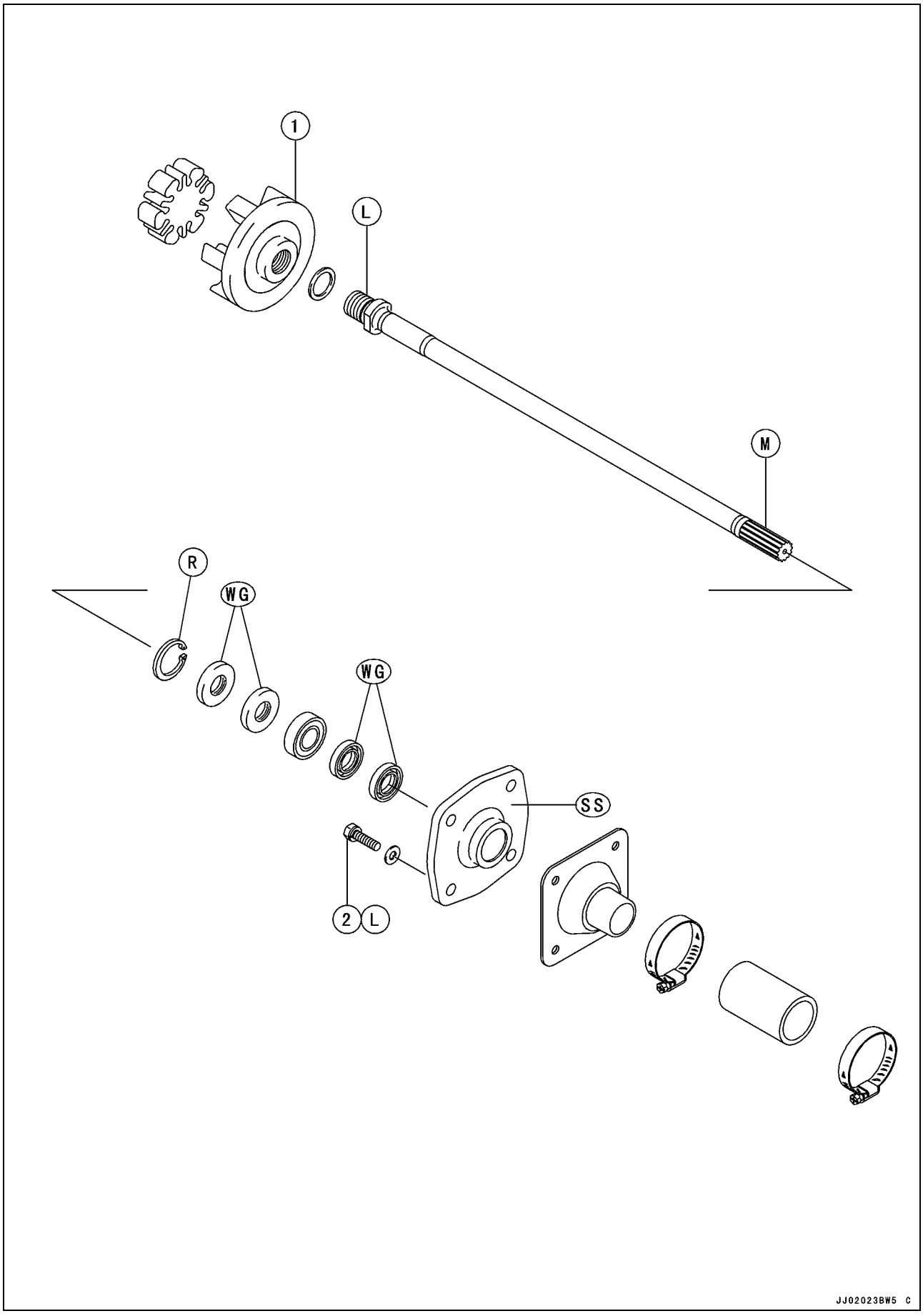
## Exploded View



## Exploded View

| No. | Fastener | Torque | | | Remarks |
|---|---|---|---|---|---|
| | | N·m | kgf·m | ft·lb | |
| 1 | Coupling | 265 | 27.0 | 195 | |
| 2 | Drive Shaft Holder Mounting Bolts | 22 | 2.2 | 16 | L |

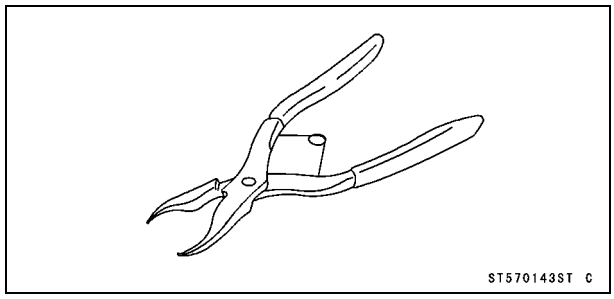
L: Apply a non-permanent locking agent.
R: Replacement Parts
M: Apply molybdenum disulfide grease.
SS: Apply silicone sealant.
WG: Apply water resistance grease.

## Specification

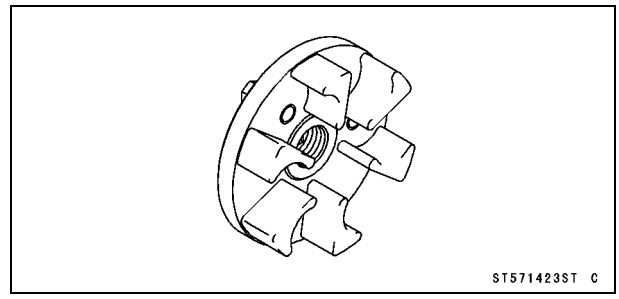
| Item | Standard | Service Limit |
|---|---|---|
| **Drive Shaft** | | |
| Runout at $\phi$19.7 ~ 19.8 mm (0.776 ~ 0.780 in.) position | – – – | 0.1 mm (0.0039 in.) |
| at $\phi$18.8 ~ 19.2 mm (0.740 ~ 0.756 in.) position | – – – | 0.2 mm (0.0079 in.) |

## Special Tools

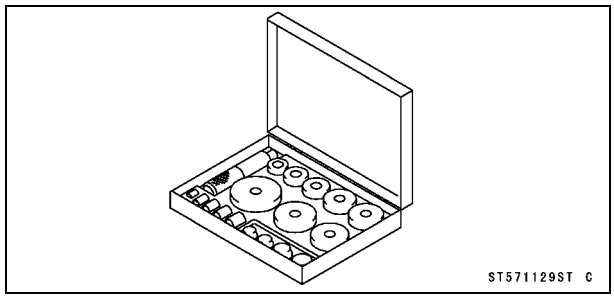
**Inside Circlip Pliers:**
**57001-143**




**Coupling Holder #2:**
**57001-1423**



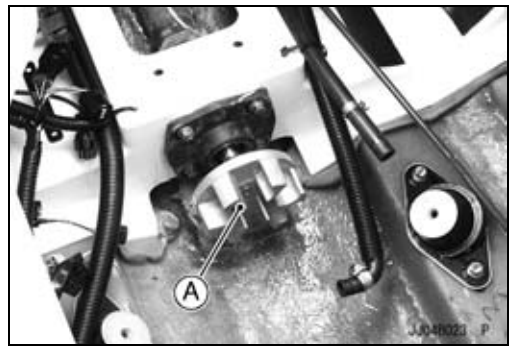

**Bearing Driver Set:**
**57001-1129**



## Drive Shaft/Drive Shaft Holder

### *Drive Shaft Removal*

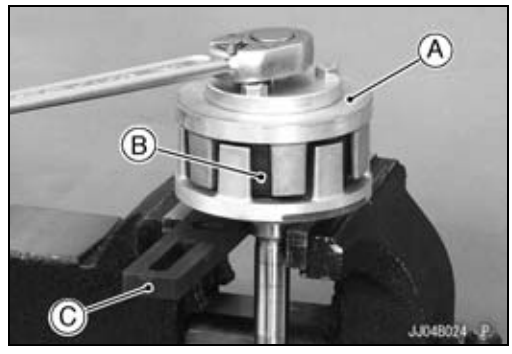
- Remove the engine (see Engine Removal in the Engine Removal/Installation chapter).
- Remove the drive shaft together with the coupling [A] out of the hull.




- Hold the drive shaft in a vise, and loosen the coupling with the coupling holder [A].

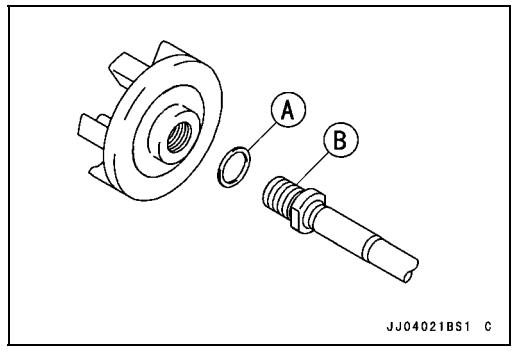
**Special Tool - Coupling Holder #2: 57001-1423**

○Install the coupling damper [B] to the coupling holder.
○In the photo, install the suitable tool [C] between the drive shaft and vise so that the drive shaft might set straight.




### *Drive Shaft Installation*

- Install the washer [A] on the drive shaft.
- Apply a non-permanent locking agent to the threads [B] of the drive shaft.

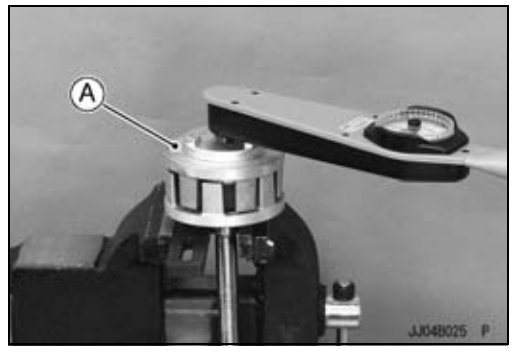



- Tighten:

**Torque - Coupling: 265 N·m (27.0 kgf·m, 195 ft·lb)**

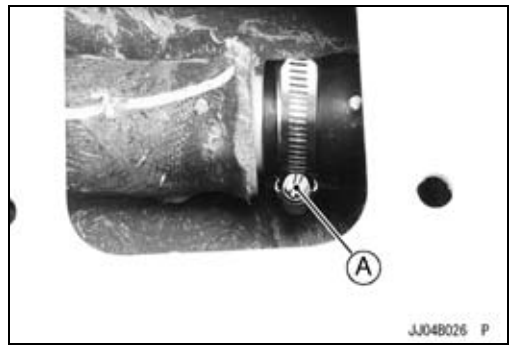
**Special Tool - Coupling Holder #2: 57001-1423 [A]**

- Apply molybdenum disulfide grease to the drive shaft spline.
- Install the drive shaft to the hull.



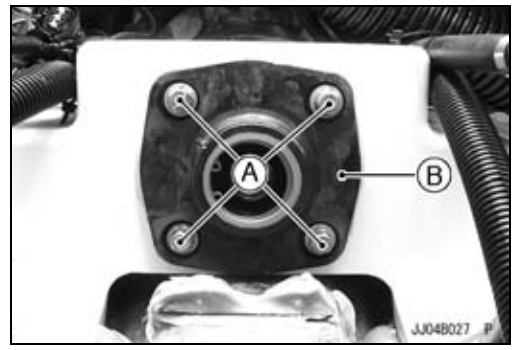

### *Drive Shaft Holder Removal/Disassembly*

- Loosen the clamp screw [A].

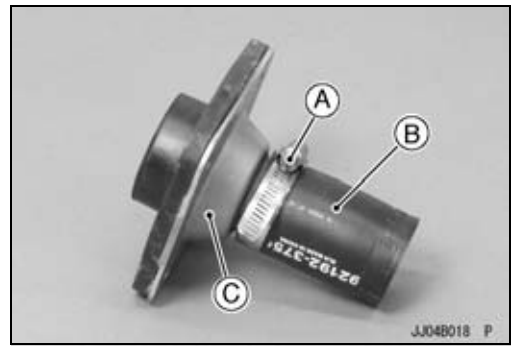


## Drive Shaft/Drive Shaft Holder

- Remove:
  Drive Shaft (see Drive Shaft Removal)
  Drive Shaft Holder Mounting Bolts [A]
- Remove the drive shaft holder [B] together with the pipe and tube.

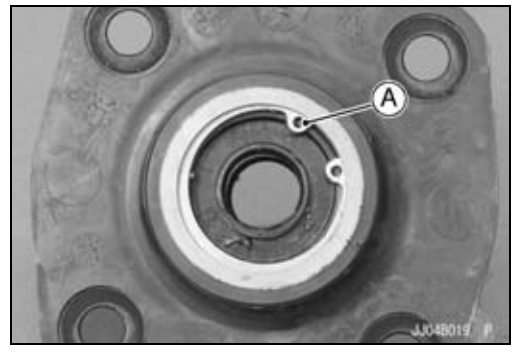



- Loosen the clamp screw [A].
- Remove:
  Tube [B]
  Pipe [C]



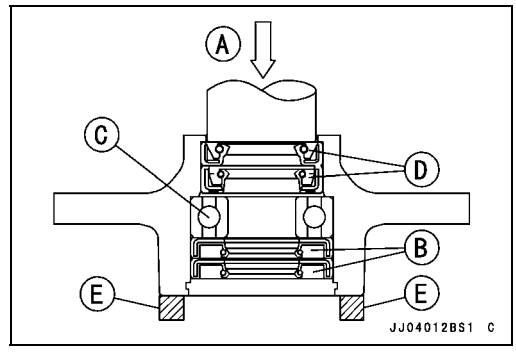

- Remove the circlip [A].

**Special Tool - Inside Circlip Pliers: 57001-143**



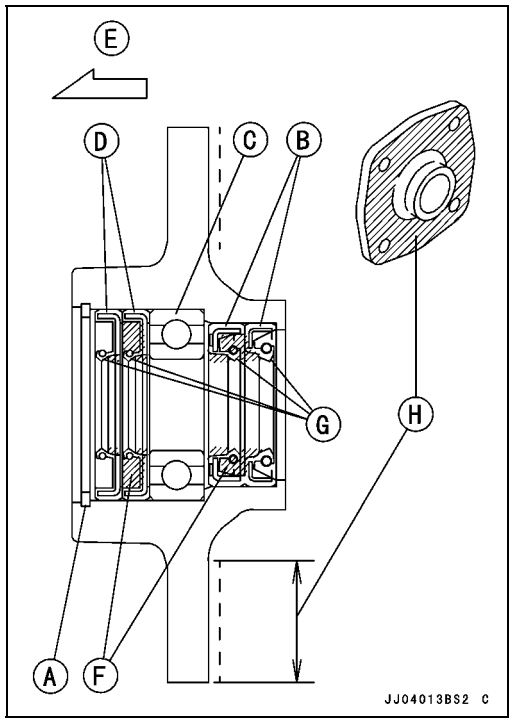

- Using the press, press [A] the small grease seal to remove the large grease seals [B], bearing [C] and small grease seals [D] come out of the holder.
  [E] Blocks

**Special Tool - Bearing Driver Set: 57001-1129**



## Drive Shaft/Drive Shaft Holder

### *Drive Shaft Holder Assembly/Installation*




- Replace the grease seals, bearing and circlip [A] with new ones.
- Using a press, press the bearing and grease seals into the drive shaft holder, noting the following.

**Special Tool - Bearing Driver Set: 57001-1129**

○Install the parts in this order.
Two Small Grease Seals [B]
One Bearing [C]
Two Large Grease Seals [D]
Front [E]

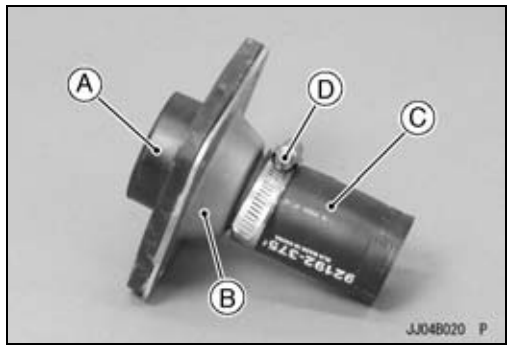
○Install the seals so that the sides with the spring face outward.

○Fill the gaps between the seals with water resistance grease [F].

- Install the circlip.

**Special Tool - Inside Circlip Pliers: 57001-143**

- Apply water resistance grease to the bearing inner surface and grease seal lips [G].
- Strip off the old sealant on the mating surface.
- Apply silicone sealant to the mating surface [H] of the drive shaft holder.



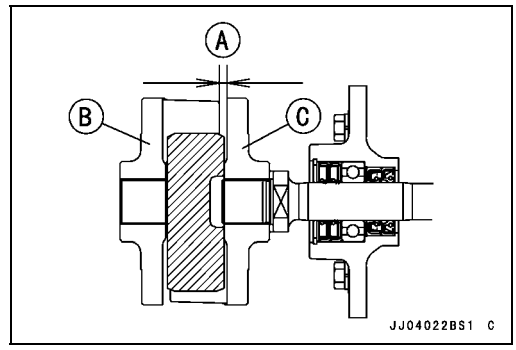

- Stick the drive shaft holder [A] and pipe [B].
- Install the tube [C] securely.
- Tighten the clamp screw [D].

- Install the drive shaft holder on the bulkhead so that the circlip side face toward the front.
- Tighten the clamp screw [A].
- Apply a non-permanent locking agent to the drive shaft holder mounting bolts, tighten them loosely.
- Install the drive shaft (see Drive Shaft Installation).
- After installing the engine, tighten the drive shaft holder mounting bolts to the specified torque to give proper coupling alignment.

**Torque - Drive Shaft Holder Mounting Bolts: 22 N·m (2.2 kgf·m, 16 ft·lb)**

## Drive Shaft/Drive Shaft Holder

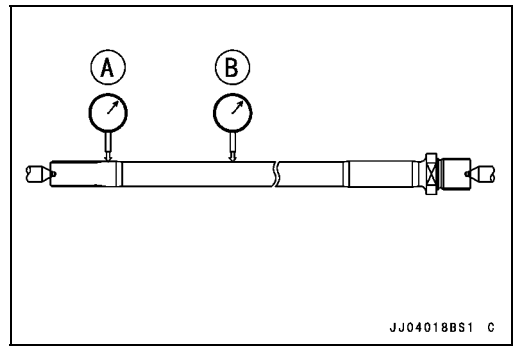
- Make sure the clearance [A] between the engine coupling [B] and the drive shaft coupling [C] is 3 to 5 mm (0.12 to 0.20 in.).




### *Drive Shaft Runout Inspection*

- Measure drive shaft runout by supporting the shaft in alignment jig and setting a dial gauge against the shaft at each point shown.
- Turn the drive shaft slowly. The difference between the highest and lowest dial gauge reading is the runout.

★If any measurement exceeds the service limit, replace the shaft.




**Drive Shaft Runout**

**Service Limit: 0.1 mm (0.0039 in.) [A] at $\phi$19.7 ~ 19.8 mm (0.776 ~ 0.780 in.) position**

**0.2 mm (0.0079 in.) [B] at $\phi$18.8 ~ 19.2 mm (0.740 ~ 0.756 in.) position**

# Pump and Impeller

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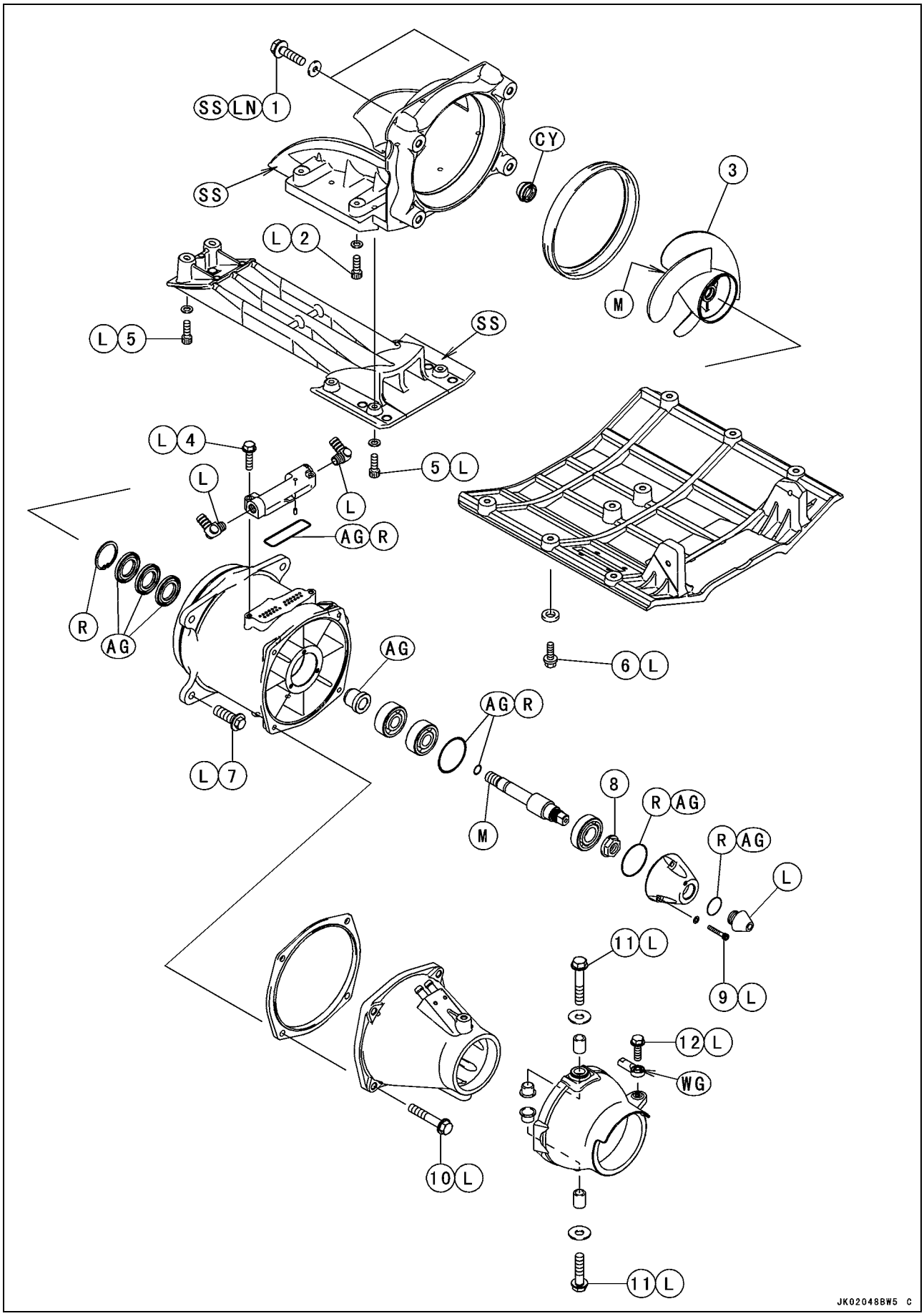
## Exploded View



## Exploded View

| No. | Fastener | Torque | | | Remarks |
|---|---|---|---|---|---|
| | | N·m | kgf·m | ft·lb | |
| 1 | Pump Bracket Mounting Bolts (M8) | 19 | 1.9 | 14 | LN, SS |
| 2 | Pump Bracket Mounting Bolts (M6) | 9.8 | 1.0 | 87 in·lb | L |
| 3 | Impeller | 147 | 15.0 | 108 | M |
| 4 | Filter Cover Mounting Bolts | 9.8 | 1.0 | 87 in·lb | L |
| 5 | Grate Mounting Bolts | 9.8 | 1.0 | 87 in·lb | L |
| 6 | Pump Cover Mounting Bolts | 7.8 | 0.80 | 69 in·lb | L |
| 7 | Pump Mounting Bolts | 36 | 3.7 | 27 | L |
| 8 | Pump Shaft Nut | 98 | 10 | 72 | |
| 9 | Pump Cap Bolts | 3.9 | 0.40 | 35 in·lb | L |
| 10 | Pump Outlet Mounting Bolts | 19 | 1.9 | 14 | L |
| 11 | Steering Nozzle Pivot Bolts | 19 | 1.9 | 14 | L |
| 12 | Steering Cable Joint Bolt | 9.8 | 1.0 | 87 in·lb | L |

AG: Apply lithium grease (NLGI Grade No.2).
CY: Apply cyanoacrylate cement.
L: Apply a non-permanent locking agent.
LN: Apply a non-permanent locking agent (High Strength: Loctite 271 equivalent).
M: Apply molybdenum disulfide grease.
R: Replacement Parts
SS: Apply silicone sealant.
WG: Apply water-resistance grease.

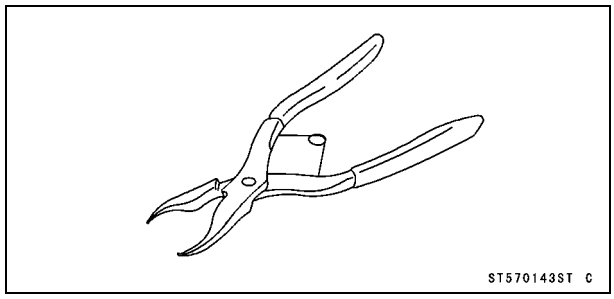
# 11-4 PUMP AND IMPELLER

## Specifications

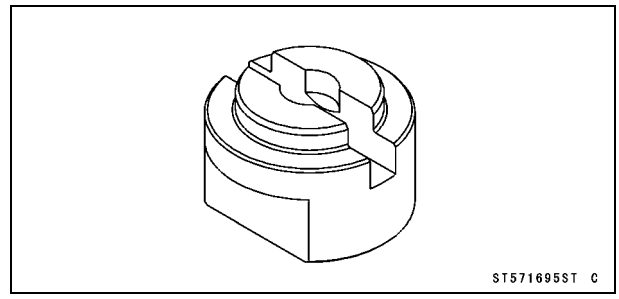
| Item | Standard | Service Limit |
|---|---|---|
| **Jet Pump** | | |
| Impeller Outside Diameter | 154.5 ~ 154.7 mm (6.083 ~ 6.091 in.) | 153.5 mm (6.043 in.) |
| Pump Case Inside Diameter | 155.0 ~ 155.1 mm (6.102 ~ 6.106 in.) | 156.1 mm (6.146 in.) |
| Impeller Clearance | 0.15 ~ 0.3 mm (0.0059 ~ 0.012 in.) | 0.6 mm (0.024 in.) |

## Special Tools and Sealant

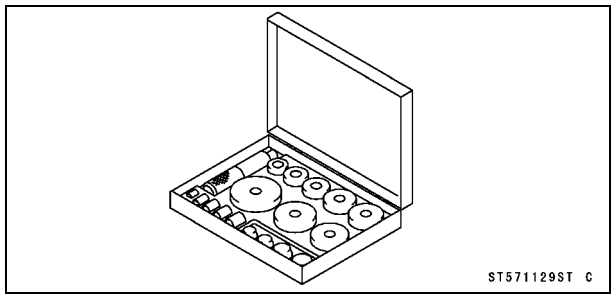
**Inside Circlip Pliers:**
**57001-143**



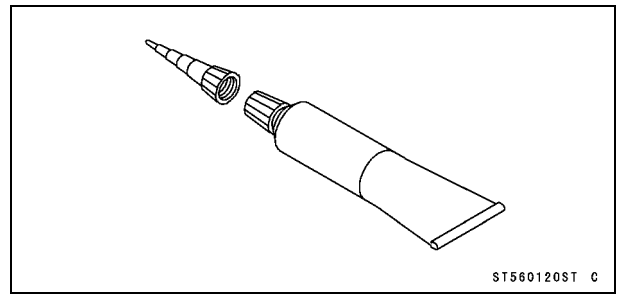

**Impeller Holder:**
**57001-1695**



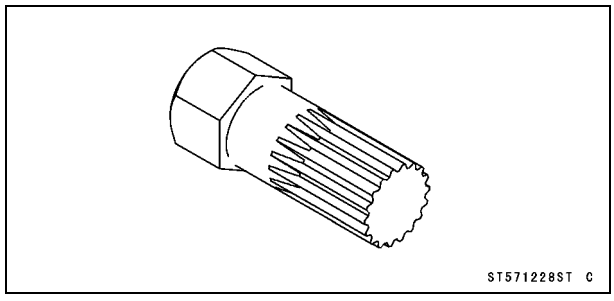

**Bearing Driver Set:**
**57001-1129**




**Liquid Gasket, TB1211:**
**56019-120**



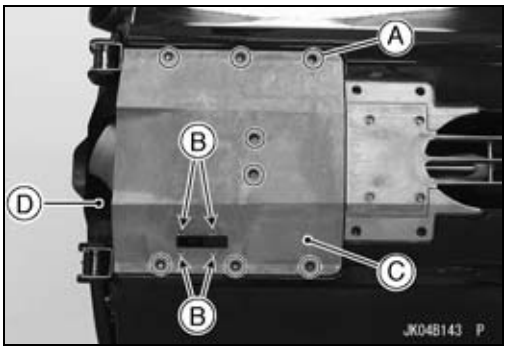

**Impeller Wrench:**
**57001-1228**



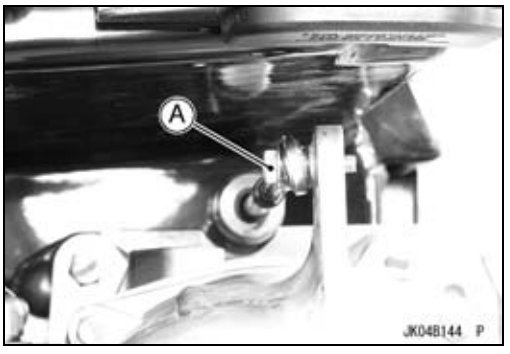
## Pump and Impeller

### *Pump Removal*

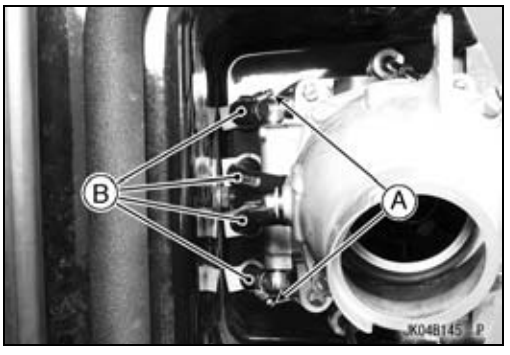
- Turn the craft on its left side.
- Disconnect the shift cable ball joint at the rear end (see Shift Cable Removal in the Steering chapter).
- Remove:
  Pump Cover Mounting Bolts [A] and Washers
  Speed Sensor Screws [B]
- Remove the pump cover [C] with the reverse bucket [D].



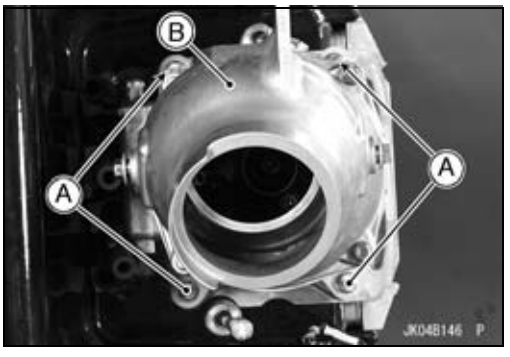

- Remove the joint bolt [A] to free the steering cable joint.




- Loosen the clamps [A] on the intake water hoses, and pull off the hoses [B].

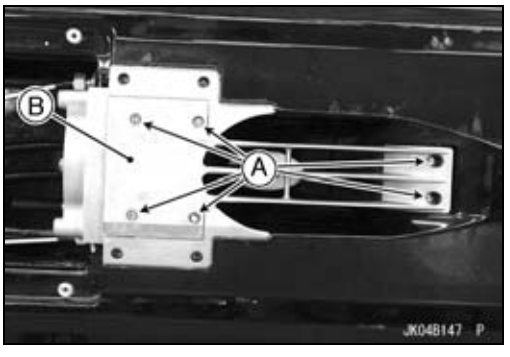



- Remove the pump mounting bolts [A].
- Slide the pump [B] rearward to disengage the drive shaft, and remove it from the hull.



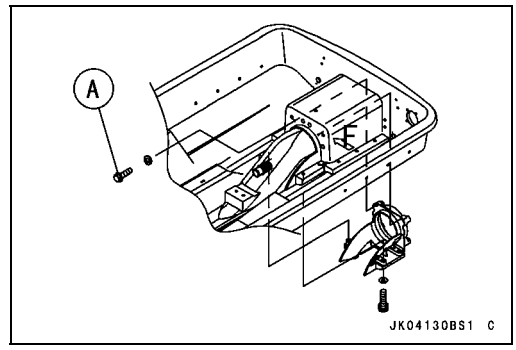

- To remove the pump bracket, perform the following procedures.

○Remove:
  Bolts [A] and Washers
  Grate [B]

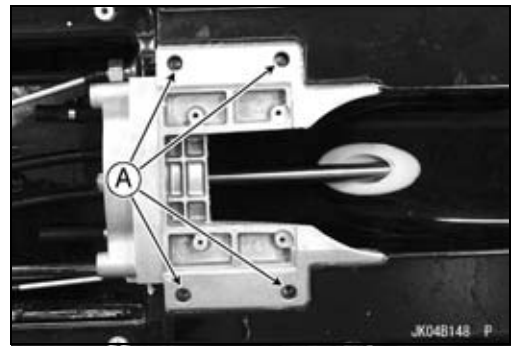


## Pump and Impeller

○Take out the pump bracket mounting bolts [A] and washers in the hull.




○Take out the pump bracket mounting bolts [A] and washers.

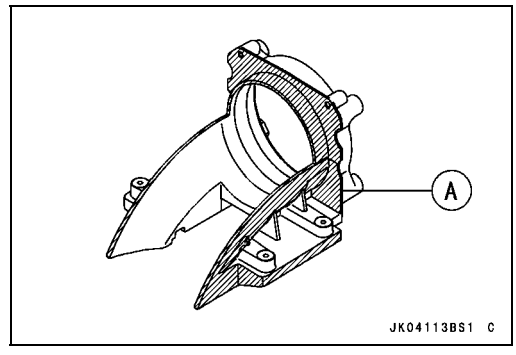



○Cut the sealant at the indicated area [A] in the figure and remove the pump bracket [B].

### *Pump Installation*

- Strip off all the old sealant around the pump bracket.
- Liberally coat the outside edge of the pump bracket with silicon sealant [A] to form a seal between the bracket and the hull.

**Sealant - Liquid Gasket, TB1211: 56019-120**



## Pump and Impeller

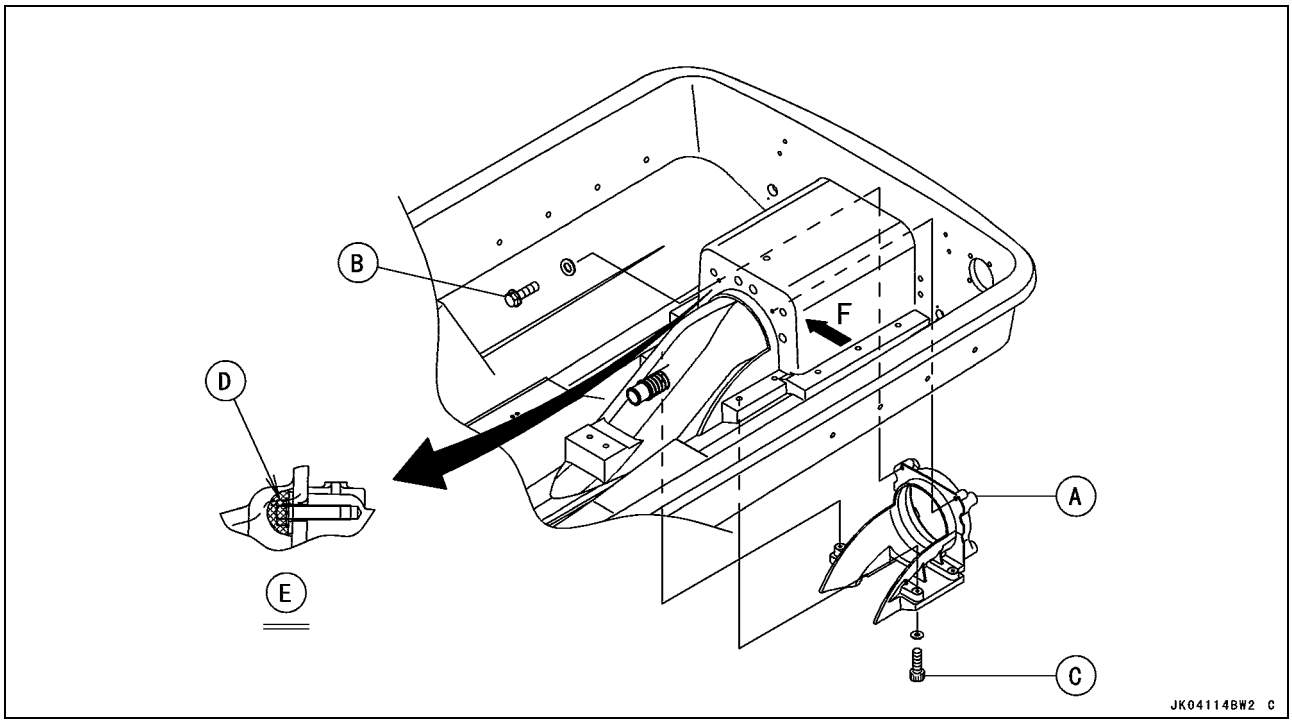
- Install the pump bracket [A] to the hull.
- Apply a non-permanent locking agent (High Strength: Loctite 271 equivalent) to the pump bracket mounting bolts (M8) [B], and tighten them and washers.

**Torque - Pump Bracket Mounting Bolts (M8): 19 N·m (1.9 kgf·m, 14 ft·lb)**

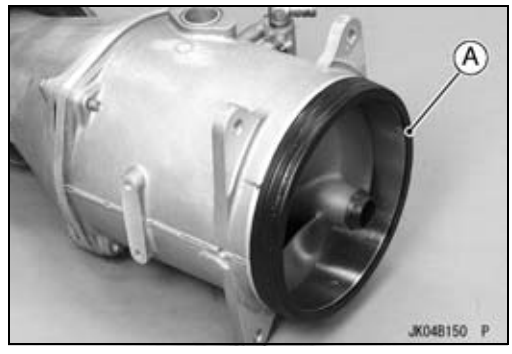
- Apply a non-permanent locking agent to the pump bracket mounting bolts (M6) [C], and tighten them and washers.

**Torque - Pump Bracket Mounting Bolts (M6): 9.8 N·m (1.0 kgf·m, 87 in·lb)**

○As for the pump bracket mounting bolts (M8) in the hull, the bolt heads should be wrapped in silicone sealant [D].
[E] View F



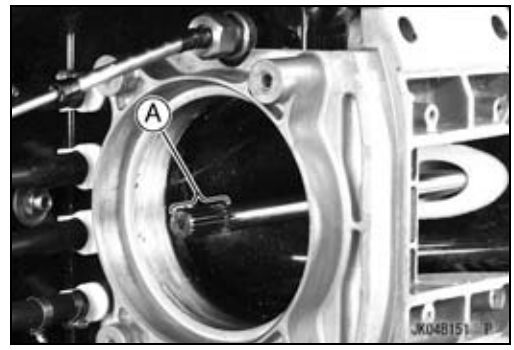

- Be sure trim seal [A] is in place.



## Pump and Impeller

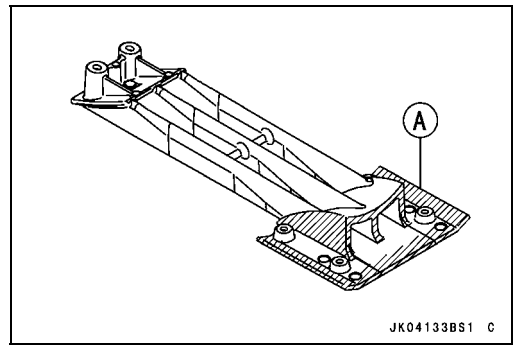
- Apply molybdenum disulfide grease to the spline [A] on the drive shaft.
- Install the pump.
- Apply a non-permanent locking agent to the pump mounting bolts, and tighten them with the washers.

**Torque - Pump Mounting Bolts: 36 N·m (3.7 kgf·m, 27 ft·lb)**



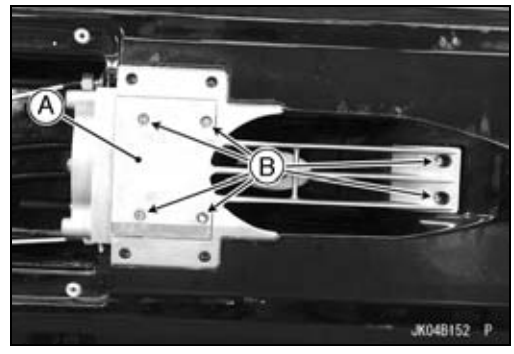

- Apply silicone sealant [A] to the grate.

**Sealant - Liquid Gasket, TB1211: 56019-120**



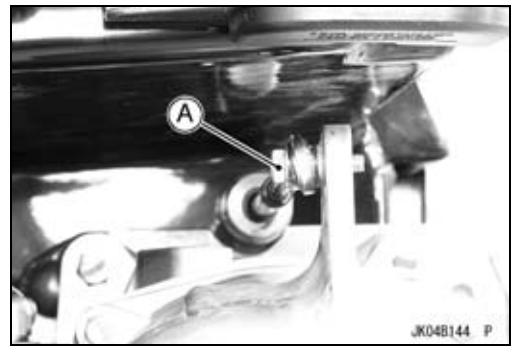

- Install the grate [A].
- Apply a non-permanent locking agent to the grate mounting bolts [B], and tighten them with the washers.

**Torque - Grate Mounting Bolts: 9.8 N·m (1.0 kgf·m, 87 in·lb)**

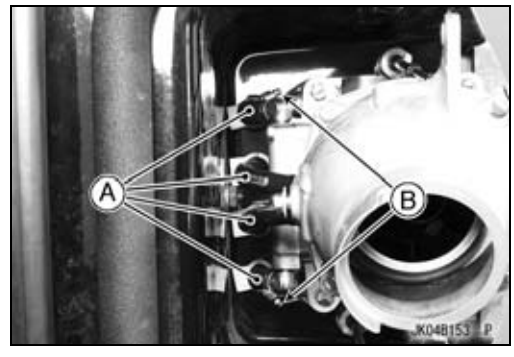



- Apply water-resistance grease to the joint ball.
- Apply a non-permanent locking agent to the steering cable joint bolt [A], and tighten it.

**Torque - Steering Cable Joint Bolt: 9.8 N·m (1.0 kgf·m, 87 in·lb)**



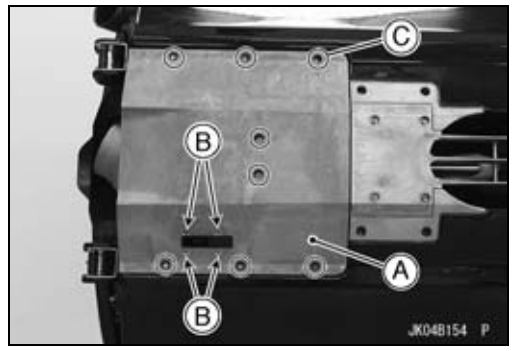

- Install the intake water hoses [A] to the pump, and tighten the clamp screws [B].



## Pump and Impeller

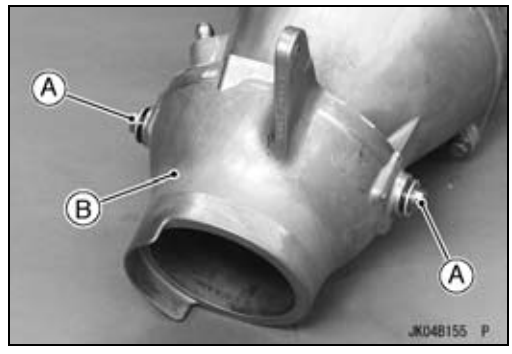
- Install the speed sensor to the pump cover [A] with the screws [B].
- Install the pump cover.
- Apply a non-prmanent locking agent to the pump cover mounting bolts [C], and tighten them.

**Torque - Pump Cover Mounting Bolts: 7.8 N·m (0.80 kgf·m, 69 in·lb)**

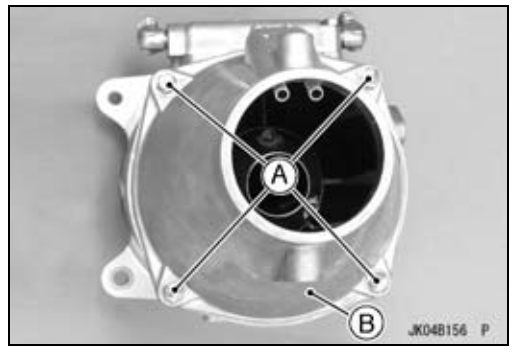



### *Pump Disassembly*

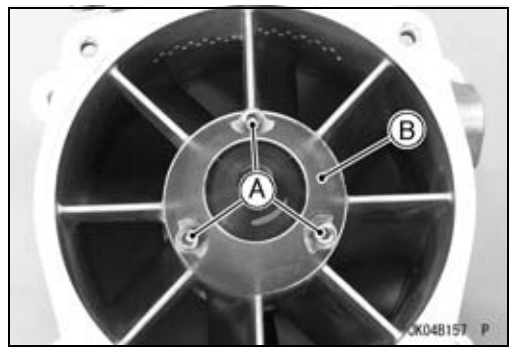
- Remove:
  Steering Nozzle Pivot Bolts [A] and Washers
  Steering Nozzle [B]



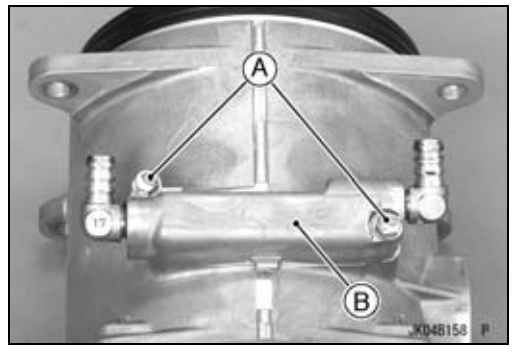

- Remove:
  Pump Outlet Mounting Bolts [A]
  Pump Outlet [B]
  Spacer




- Remove:
  Pump Cap Bolts [A] and Washers
  Pump Cap [B]

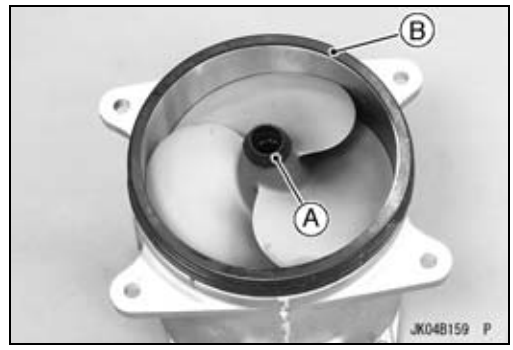



- Remove:
  Filter Cover Mounting Bolts [A]
  Filter Cover [B]
  O-ring
  Dowel Pin

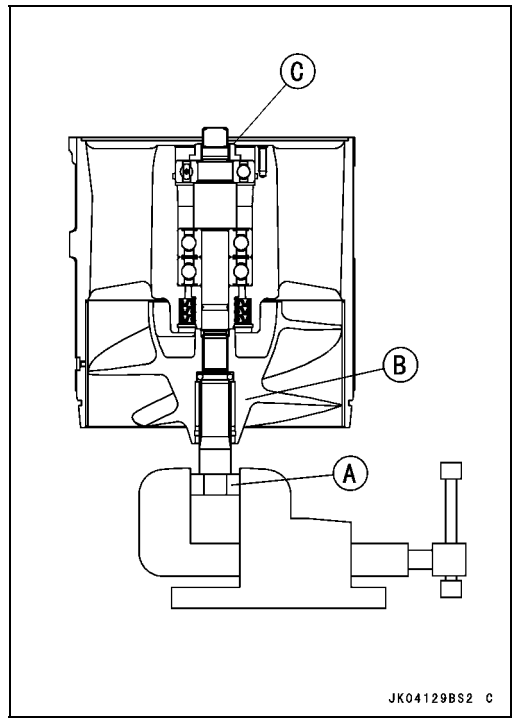


## Pump and Impeller

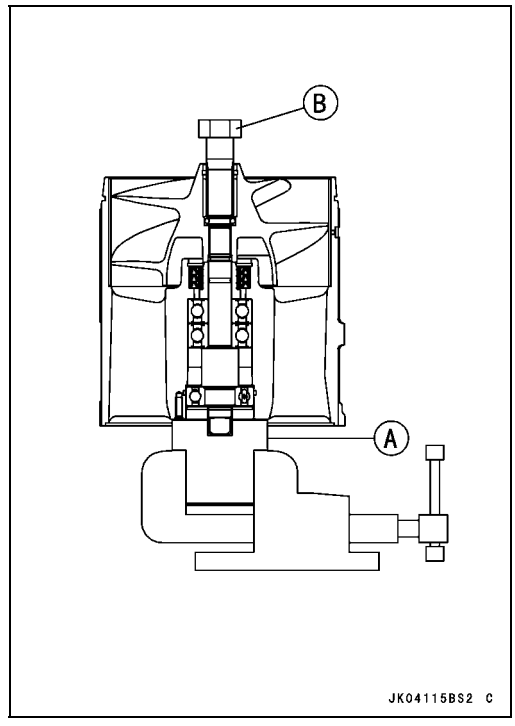
- Remove:
  Impeller Seal [A]
  Trim Seal [B]




- Install the impeller wrench [A] into the impeller [B].
  **Special Tool - Impeller Wrench: 57001-1228**
- Turn the pump case upside down, and hold the impeller wrench with a vise.
- Remove the pump shaft nut [C].

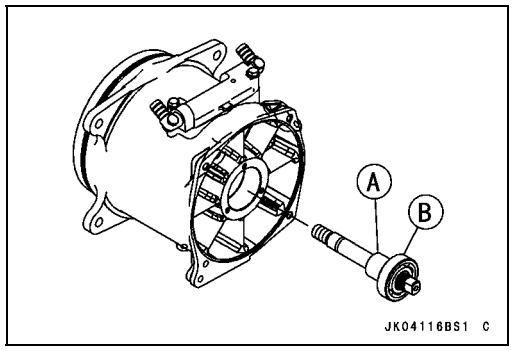



- Using a vise, hold the shaft in the impeller holder [A], taking care not to damage it.
- Insert the impeller wrench [B] to the impeller.
  **Special Tools - Impeller Wrench: 57001-1228**
  **Impeller Holder: 57001-1695**
- Loosen the impeller wrench to remove the impeller from the pump shaft.

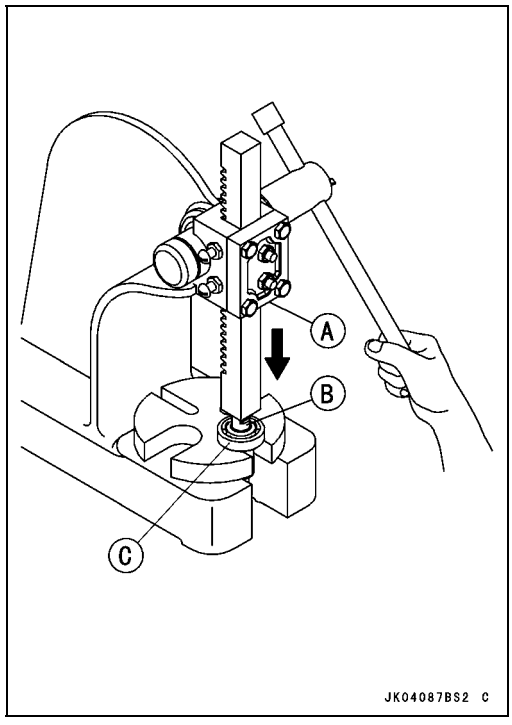


## Pump and Impeller

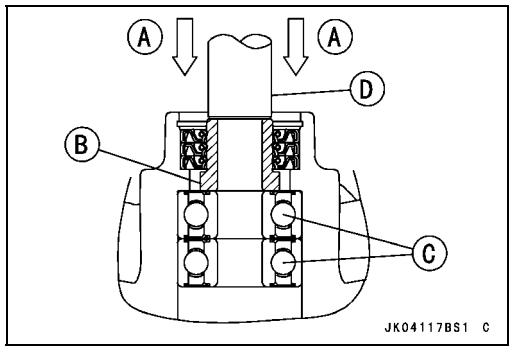
- Pull the pump shaft [A] together with the bearing [B] from the pump case.




- Remove the bearing [C] from the pump shaft [B] with a press [A].




- Using a press, press [A] the bushing [B] and the ball bearings [C] with a suitable bar [D] of $\phi$25 mm (0.98 in.) × L = 65 mm (2.6 in.) over. They come out of the pump case.
- Discard the removed bearings.



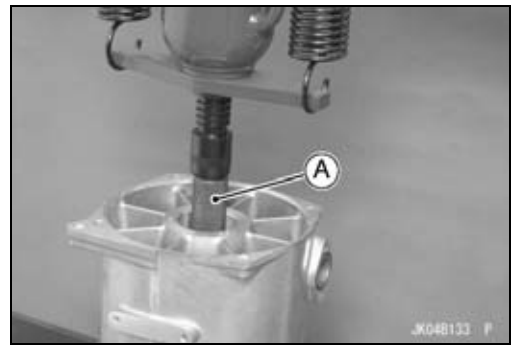

- Remove the circlip [A].

  **Special Tool - Inside Circlip Pliers: 57001-143**

## Pump and Impeller

- Using a press, remove the grease seals.

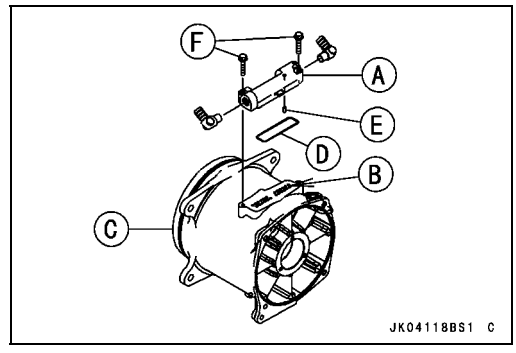
  **Special Tool - Bearing Driver Set: 57001-1129 [A]**



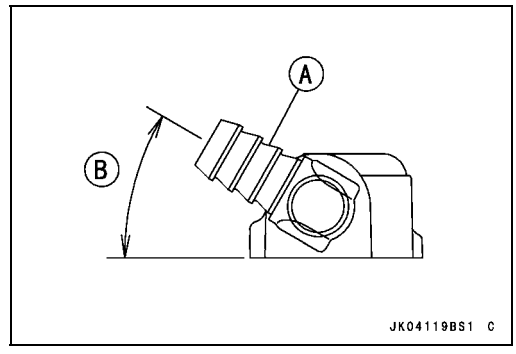

### *Pump Assembly*

- Before installing the pump bearing, blow any dirt or foreign particles out of the pump case with compressed air.
- Before installing the pump bearing, remove the filter cover [A], and check the filter inside or outside [B] on the pump case [C] if the foreign particles do not cling to the filter.
- Replace the O-ring [D] with a new one, and install it.
- Install the dowel pin [E].
- Apply lithium grease (NLGI Grade No.2) to the O-ring.
- Apply a non-permanent locking agent to the filter cover mounting bolts [F], and tighten them.

  **Torque - Filter Cover Mounting Bolts: 9.8 N·m (1.0 kgf·m, 87 in·lb)**




- Apply a non-permanent locking agent to the threads of the hose joints [A].
- Install the hose joints as shown.
  [B] 30°

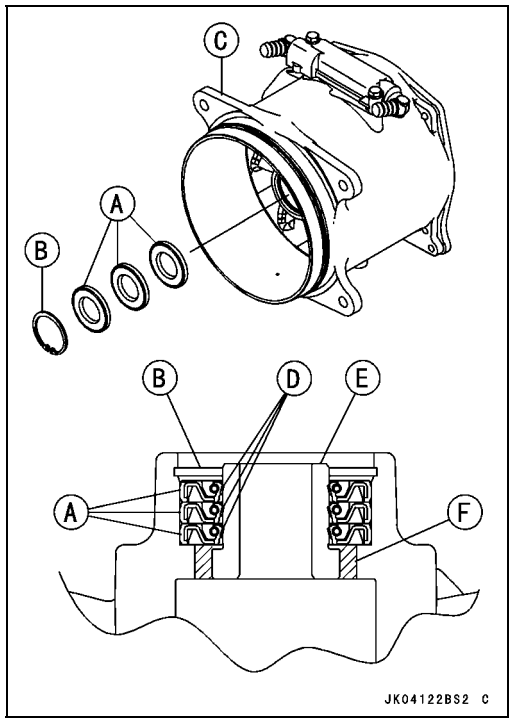


## Pump and Impeller

- Replace the grease seals [A] and circlip [B] with new ones.
- Using a press, press each seal into the pump case [C] so that the side with the spring faces outward.

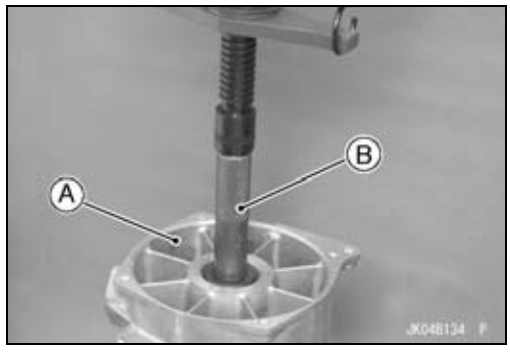
  **Special Tool - Bearing Driver Set: 57001-1129**
- Fill the gap between the grease seals with lithium grease (NLGI Grade No.2) and apply it each grease seal lip [D].
- Install the circlip.

  **Special Tool - Inside Circlip Pliers: 57001-143**
- Install the bushing [E] into the pump case.
- Fill with lithium grease (NLGI Grade No.2) [F].

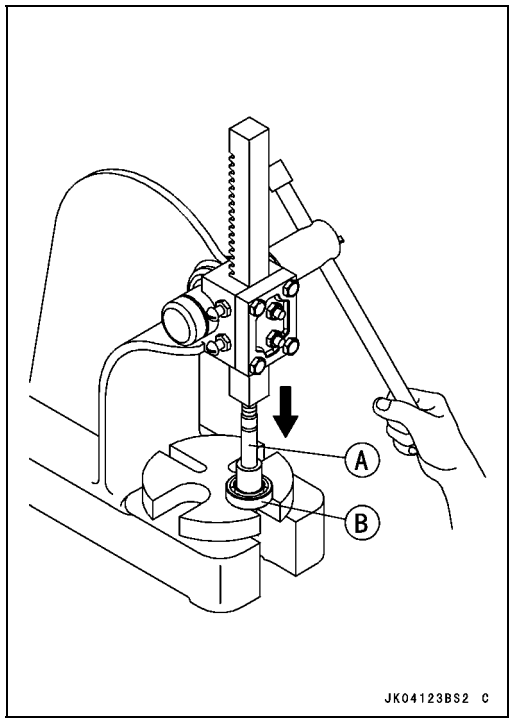



- Using a press, press the new bearings into the pump case [A] until they bottom out.

  **Special Tool - Bearing Driver Set: 57001-1129 [B]**

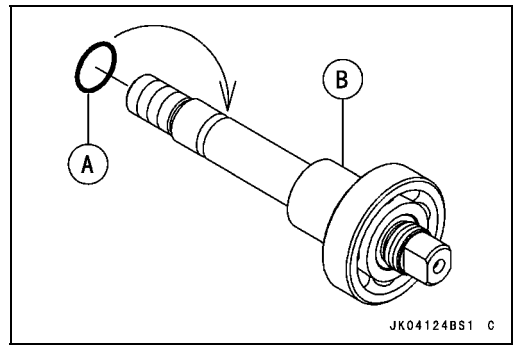



- Using a press, install the pump shaft [A] into the bearing [B] until it bottoms out.

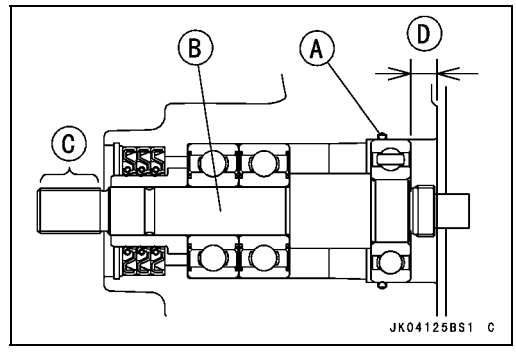


## Pump and Impeller

- Replace the O-ring [A] with a new one.
- Install the O-ring over the pump shaft [B].
- Apply lithium grease (NLGI Grade No.2) to the O-ring.




- Replace the O-ring [A] with a new one, and install it.
- Apply lithium grease (NLGI Grade No.2) to the O-ring.
- Install the pump shaft [B] into the pump case.
- Apply molybdenum disulfide grease [C] to the thread of the pump shaft
- Make sure the gap [D] between the bearing surface and pump case surface is over than 9 mm (0.35 in.).

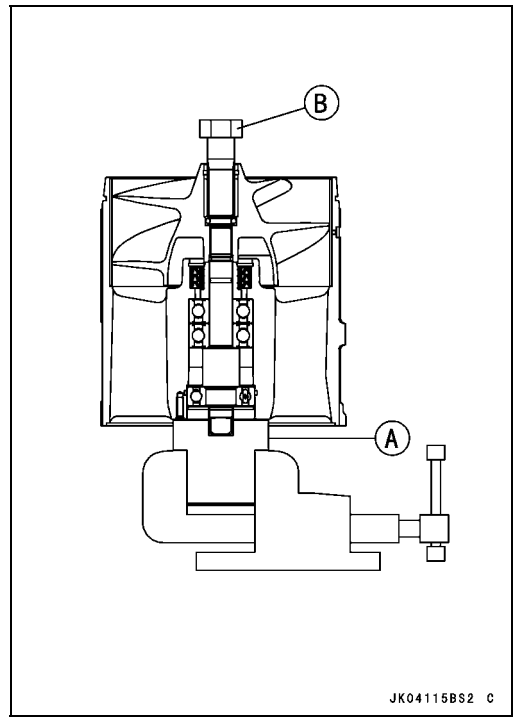



- Using a vise, hold the pump shaft in the impeller holder [A], taking care not to damage it.
- Insert the impeller wrench [B] to the impeller.

  **Special Tools - Impeller Wrench: 57001-1228**
  **Impeller Holder: 57001-1695**

- Tighten the impeller wrench with specified torque.

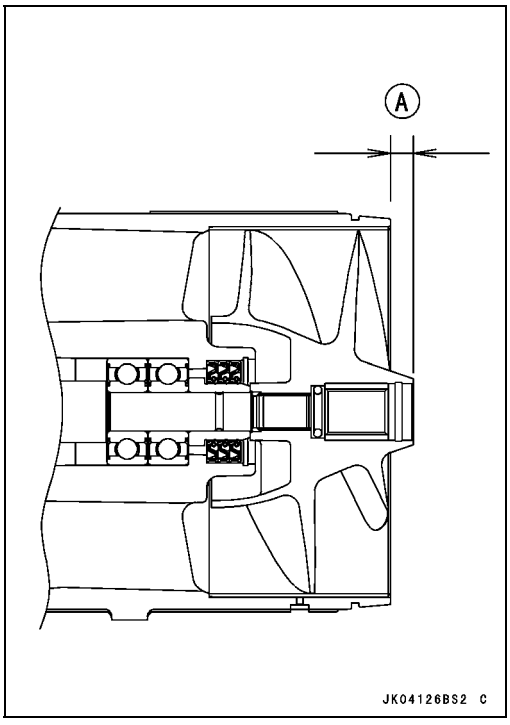
  **Torque - Impeller: 147 N·m (15.0 kgf·m, 108 ft·lb)**



## Pump and Impeller

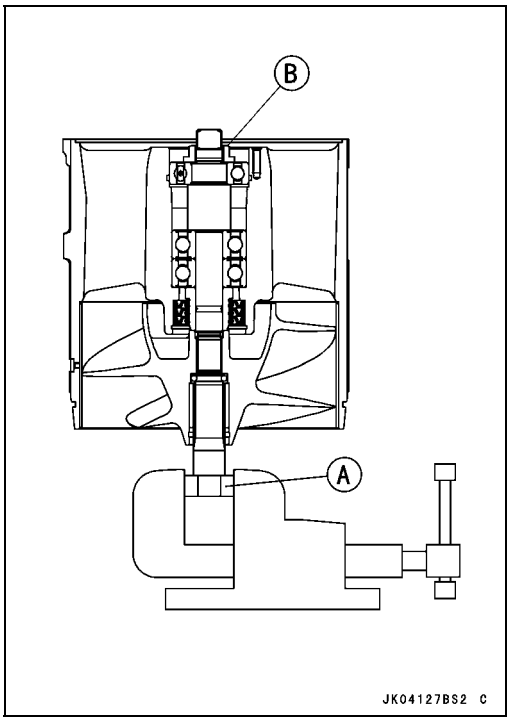
- Measure the gap [A] between impeller end and pump case end.

★If the gap is not over than 10.5 mm (0.413 in.), disassemble the pump again.

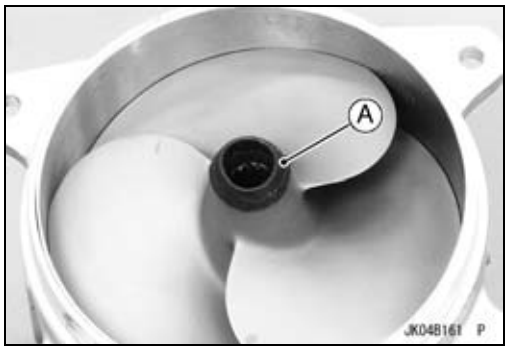



- Turn the pump case upside down.
- Using a vise, hold the pump shaft in the impeller wrench [A].
- Tighten:

**Torque - Pump Shaft Nut [B]: 98 N·m (10 kgf·m, 72 ft·lb)**

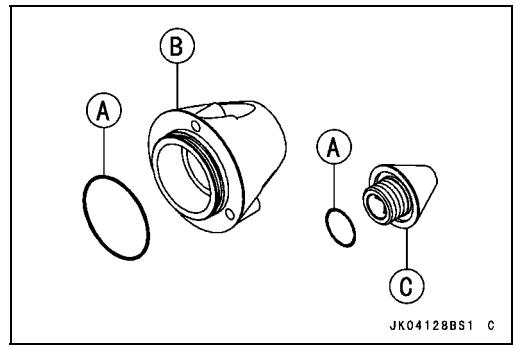



- Visually inspect impeller seal [A], and replace it if necessary.
- Apply cyanoacrylate cement to the impeller seal.
- Install the seal on the impeller.



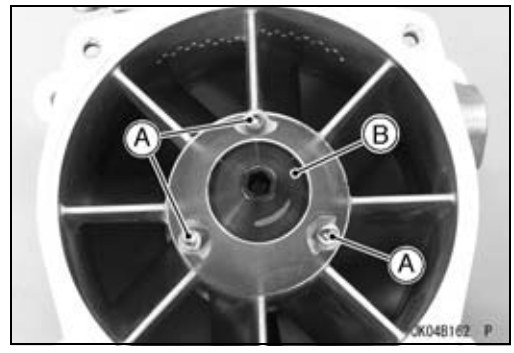
## Pump and Impeller

- Replace the O-rings [A] with new ones, and install them.
- Apply lithium grease (NLGI Grade No.2) to the O-rings.
  [B] Pump Cap
  [C] Pump Cap Plug

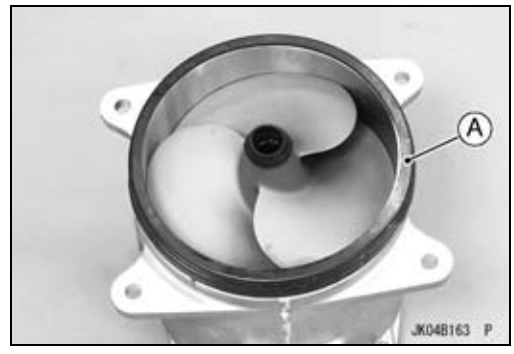



- Apply a non-permanent locking agent to the threads of the pump cap bolts [A].
- Install the pump cap bolts and washers.
- Tighten:

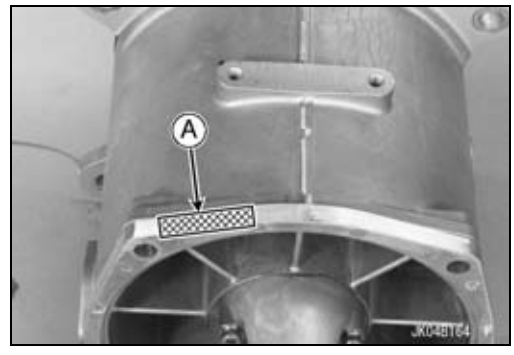
  **Torque - Pump Cap Bolts: 3.9 N·m (0.40 kgf·m, 35 in·lb)**
- Apply a non-permanent locking agent to the threads of the pump cap plug [B], and tighten it.




- Install the trim seal [A] to the pump case.

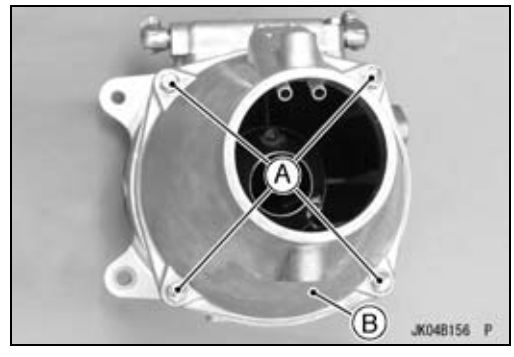



- Install the spacer so that the marked side [A] faces downward.




- Apply a non-permanent locking agent to the thread of the pump outlet mounting bolts [A].
- Install the pump outlet [B].
- Tighten:

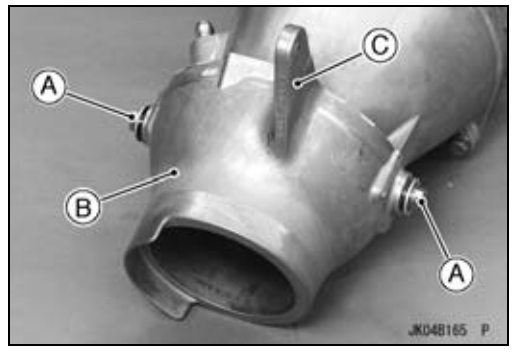
  **Torque - Pump Outlet Mounting Bolts: 19 N·m (1.9 kgf·m, 14 ft·lb)**



## Pump and Impeller

- Apply a non-permanent locking agent to the thread of the steering nozzle pivot bolts [A].
- Install the steering nozzle [B] so that the projection [C] faces rightward.
- Install the washers.
- Tighten:

**Torque - Steering Nozzle Pivot Bolts: 19 N·m (1.9 kgf·m, 14 ft·lb)**




### *Impeller Inspection*

- Refer to Impeller Inspection in the Periodic Maintenance chapter.

### *Impeller Outside Diameter Measurement*

- Remove the impeller (see Pump Disassembly).
- Measure the impeller outside diameter.

★If the impeller is worn smaller than the service limit, replace it.

**Impeller Outside Diameter**
**Standard: 154.5 ~ 154.7 mm (6.083 ~ 6.091 in.)**
**Service Limit: 153.5 mm (6.043 in.)**

### *Pump Inspection*

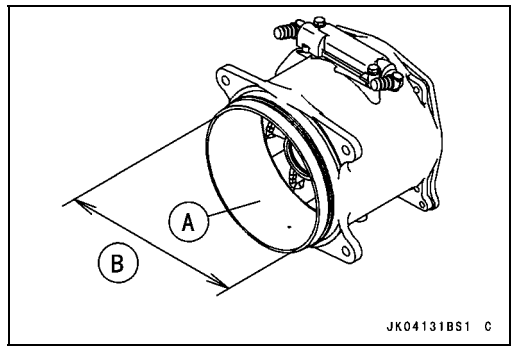
- Visually inspect the pump case [A].

★If there are deep scratches inside the pump case, replace it.

- Measure the inside diameter [B] of the pump case.

★If the pump case is worn beyond the service limit, replace it.

**Pump Case Inside Diameter**
**Standard: 155.0 ~ 155.1 mm (6.102 ~ 6.106 in.)**
**Service Limit: 156.1 mm (6.146 in.)**

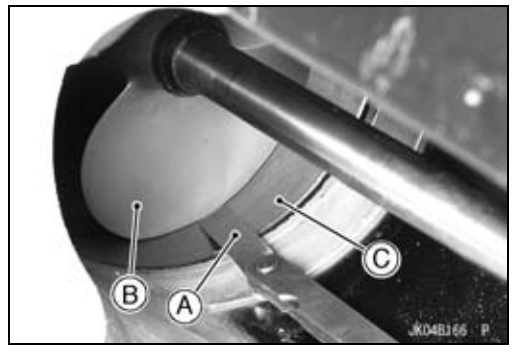



### *Impeller Clearance Inspection*

- Impeller clearance is critical to proper performance. If the pump case and impeller are not visibly damaged, poor performance may be caused by too much impeller clearance.
- To check the impeller clearance, remove the grate and insert a feeler gauge [A] between the tip of the impeller blade [B] and the pump case [C].

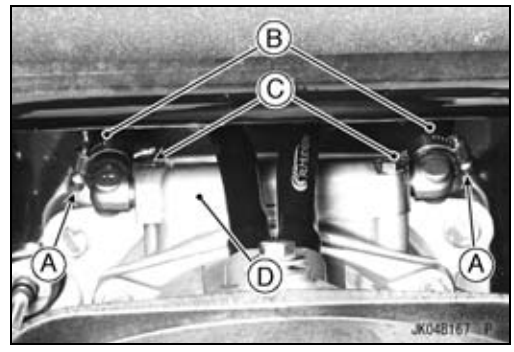
**Impeller Clearance**
**Standard: 0.15 ~ 0.3 mm (0.0059 ~ 0.012 in.)**
**Service Limit: 0.6 mm (0.024 in.)**

★If impeller clearance is incorrect, determine if it is due to wear or damage (see Pump and Impeller Inspection).



## Pump and Impeller

### *Water Filter Cover Removal/Installation*




- Loosen the clamps [A] and pull off the water hoses [B].
- Remove the filter cover mounting bolts [C].
- Take out the filter cover [D].
- Replace the O-ring with a new one.
- Apply lithium grease (NLGI Grade No.2) to the O-ring.
- Installation is the reverse order of removal.
- Apply a non-permanent locking agent to the filter cover mounting bolts, and tighten them.

**Torque - Filter Cover Mounting Bolts: 9.8 N·m (1.0 kgf·m, 87 in·lb)**

# Steering

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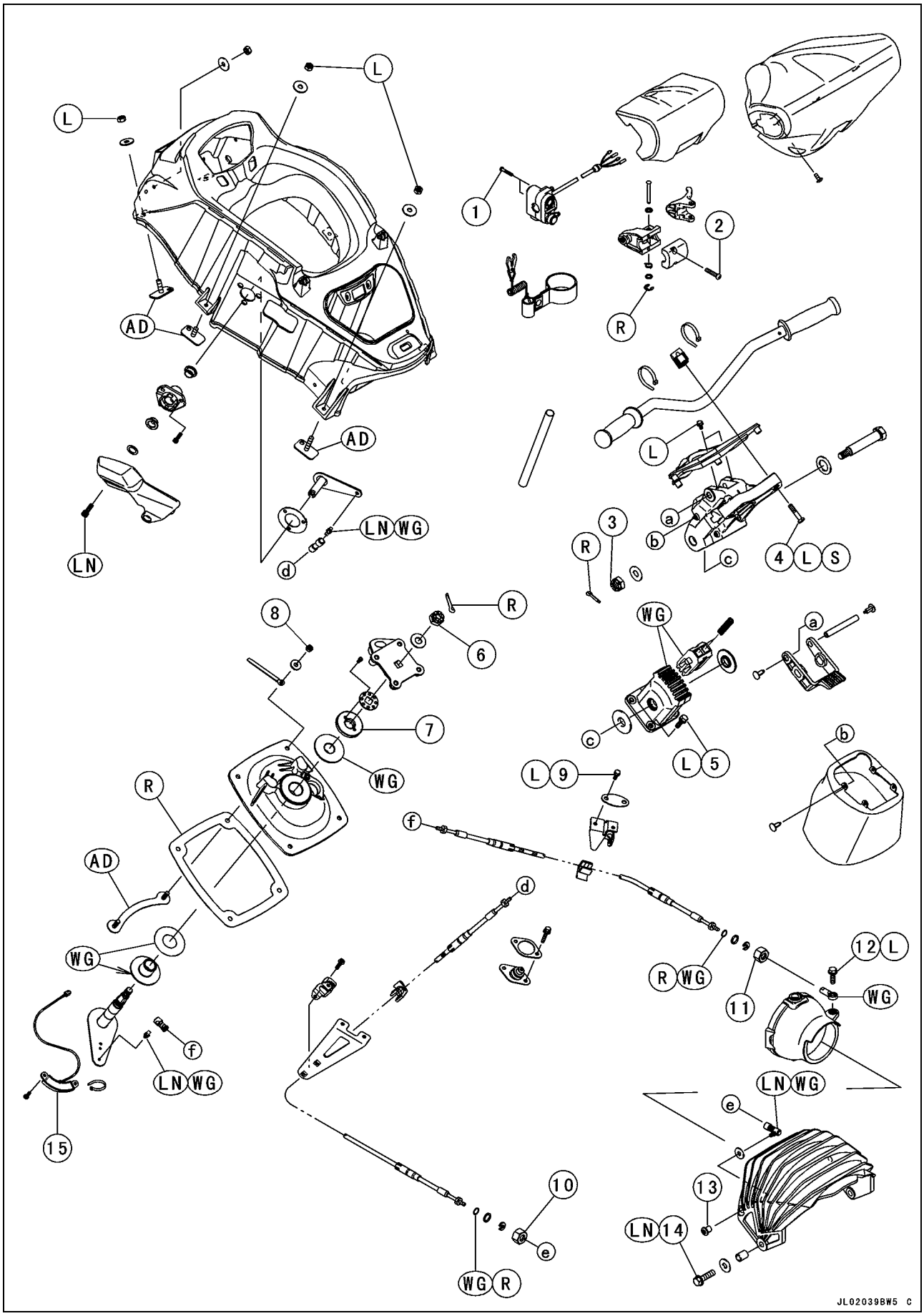
## Exploded View



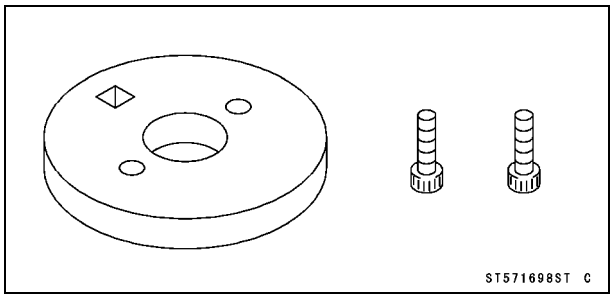
## Exploded View

| No. | Fastener | Torque | | | Remarks |
|---|---|---|---|---|---|
| | | N·m | kgf·m | ft·lb | |
| 1 | Start/Stop Switch Case Mounting Screws | 3.9 | 0.40 | 35 in·lb | |
| 2 | Throttle Case Mounting Screws | 3.9 | 0.40 | 35 in·lb | |
| 3 | Adjustable Steering Holder Nut | 4.9 | 0.50 | 43 in·lb | |
| 4 | Handlebar Clamp Bolts | 15.7 | 1.6 | 12 | L, S |
| 5 | Steering Neck Mounting Bolts | 15.7 | 1.6 | 12 | L |
| 6 | Steering Shaft Locknut | 29.4 ~ 34.3 | 3.0 ~ 3.5 | 22 ~ 25 | |
| 7 | Steering Shaft Nut | 2.9 | 0.30 | 26 in·lb | |
| 8 | Steering Holder Mounting Nuts | 19.6 | 2.0 | 14 | |
| 9 | Steering Cable Bracket Bolts | 9.8 | 1.0 | 87 in·lb | L |
| 10 | Shift Cable Nut | 39.2 | 4.0 | 29 | |
| 11 | Steering Cable Nut | 39.2 | 4.0 | 29 | |
| 12 | Steering Cable Joint Bolt | 9.8 | 1.0 | 87 in·lb | L |
| 13 | Shift Cable End Nut | 9.8 | 1.0 | 87 in·lb | |
| 14 | Reverse Bucket Pivot Bolts | 19 | 1.9 | 14 | LN |

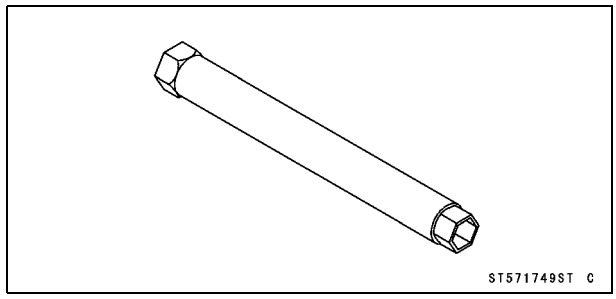
15. Steering Position Sensor
AD: Apply adhesive.
L: Apply a non-permanent locking agent.
LN: Apply a non-permanent locking agent (High Strength: Loctite 271 equivalent).
R: Replacement Parts
S: Follow the specific tightening sequence.
WG: Apply water-resistance grease.

## Special Tools

**Nut Tightening Plate:**
**57001-1698**




**Box Wrench (27 mm):**
**57001-1749**

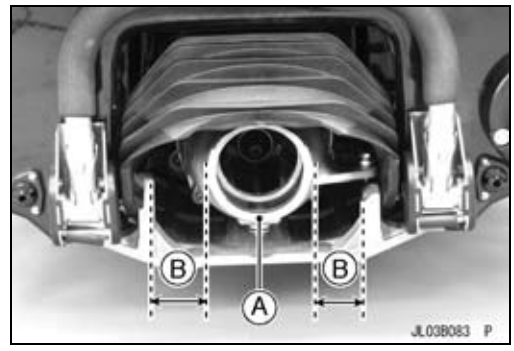


## Steering Cable

### *Steering Cable Adjustment*

- Check the steering cable adjustment.
- Center the handlebars [A] in the straight-ahead position.

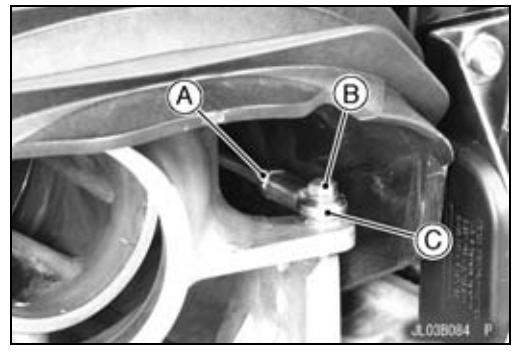
- Check that the steering nozzle [A] is centered in the pump cavity.
  Same Distance [B]




★If the nozzle position is incorrect, adjust the steering cable.

- Loosen the locknut [A] of the steering cable.
- Take out the steering cable joint bolt [B] and disconnect the cable joint [C] from the steering nozzle.
- Center the handlebars in the straight-ahead position.
- Turn the cable joint to adjust the steering.
- Temporarily tighten the cable joint bolt, and check the cable adjustment again.
- When adjustment is correct, unscrew the cable joint bolt and apply a non-permanent locking agent to it. And tighten the cable joint bolt and the steering cable locknut securely.

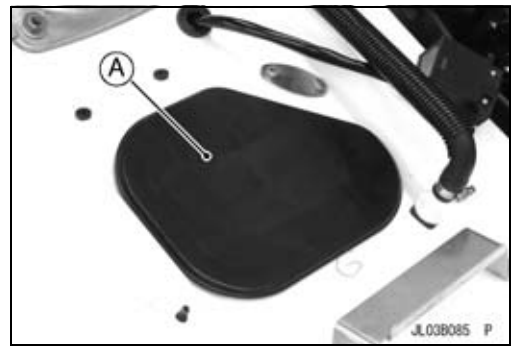
**Torque - Steering Cable Joint Bolt: 9.8 N·m (1.0 kgf·m, 87 in·lb)**




- As an additional check, turn the handlebars all the way to the left and right, and measure the distance between the nozzle and the edge of the pump cavity. It should be equal at both extremes.

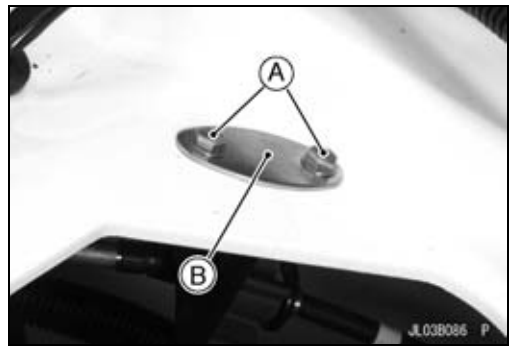
### *Steering Cable Removal*

- Remove:
  Steering Cover (see Steering Removal)
  Center Access Cover [A]

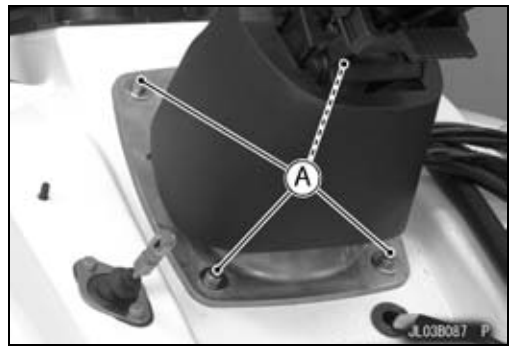


## Steering Cable

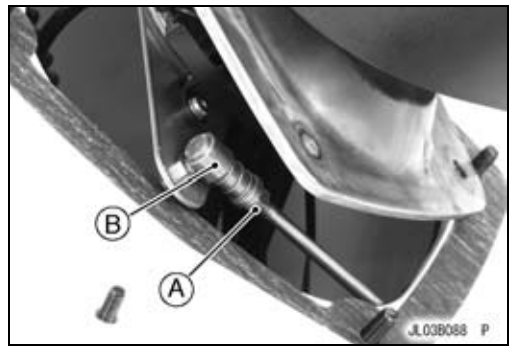
- Remove:
  Steering Cable Bracket Bolts [A]
  Plate [B]



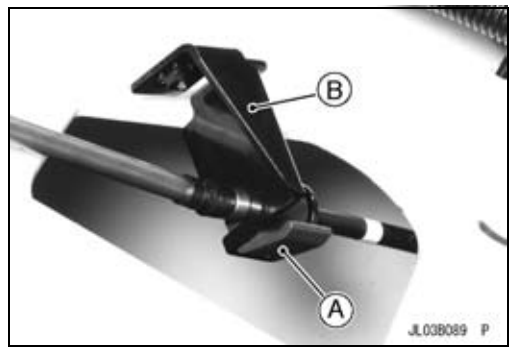

- Remove the steering holder mounting nuts [A] and washers.
- Raise the steering holder.



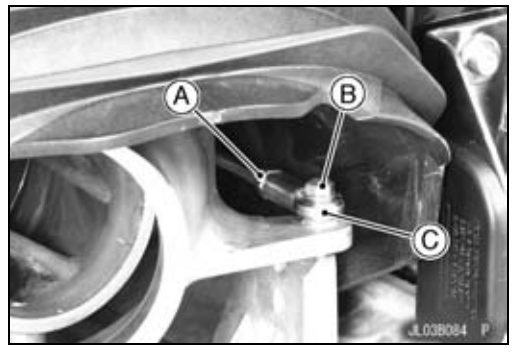

- Loosen the locknut [A].
- Slide the outer sleeve [B] to take the ball joint off the steering shaft.
- Remove the steering cable ball joint and locknut from the steering cable.




- Remove:
  Holder [A]
  Steering Cable Bracket [B]




- Loosen the locknut [A].
- Remove:
  Steering Cable Joint Bolt [B]
  Steering Cable Joint [C]
  Pump Cover (see Pump Removal in the Pump and Impeller chapter)



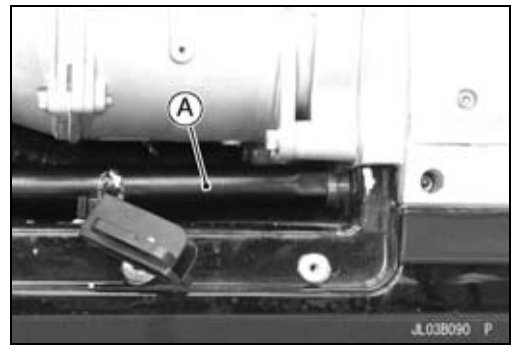
## Steering Cable

- Unscrew the large nut (steering cable nut) in the hull with the box wrench.

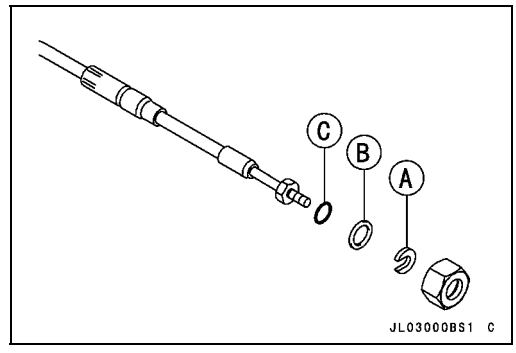
○Special tool, box wrench [A] is useful to remove the large nut (steering cable nut).

**Special Tool - Box Wrench (27 mm): 57001-1749**

○When using the box wrench, avoid bending the steering cable. Such a bend to the cable can damage it.




- Slide off the snap ring [A], washer [B] and O-ring [C].
- Pull out the steering cable toward the rear.




### *Steering Cable Installation*

- Installation is the reverse of removal. Note the following.

○Slide a short piece of rubber or plastic tubing over the front cable end to guide the cable through the hull.

○Lubricate the outside of the new cable to ease cable installation.

○Replace the O-ring with a new one.

○Apply water-resistance grease to the new O-ring.

○Tighten the steering cable nut with the box wrench.

**Special Tool - Box Wrench (27 mm): 57001-1749**

**Torque - Steering Cable Nut: 39.2 N·m (4.0 kgf·m, 29 ft·lb)**

○Engage the groove [A] on the steering cable with the opening portion [B] on the cable bracket as shown.

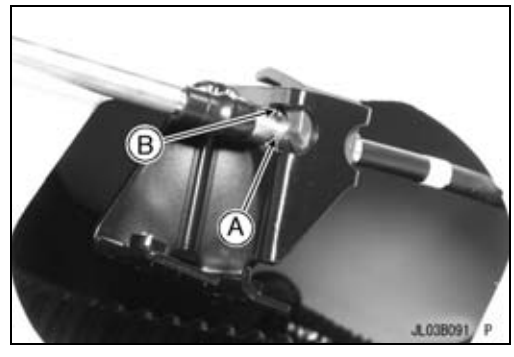
○Apply water-resistance grease to the joint ball.

○Install the steering cable both end to the joints. The steering cable ends must be inserted to the joints a minimum of 5 mm (0.2 in.).

○Apply a non-permanent locking agent to the cable joint bolt and the steering cable bracket bolts.

○Tighten:

**Torque - Steering Cable Joint Bolt: 9.8 N·m (1.0 kgf·m, 87 in·lb)**
**Steering Cable Bracket Bolts: 9.8 N·m (1.0 kgf·m, 87 in·lb)**




- Adjust the steering cable (see Steering Cable Adjustment).

### *Steering Cable Inspection*

- Refer to the Steering Cable/Shift Cable Inspection in the Periodic Maintenance chapter.

## Steering Cable

### *Steering Cable Lubrication*

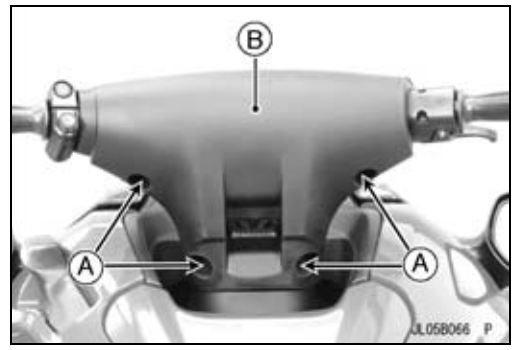
**NOTE**

○*The steering cable is sealed at each end and do not require lubrication. If the seal is damaged, the cable must be replaced.*

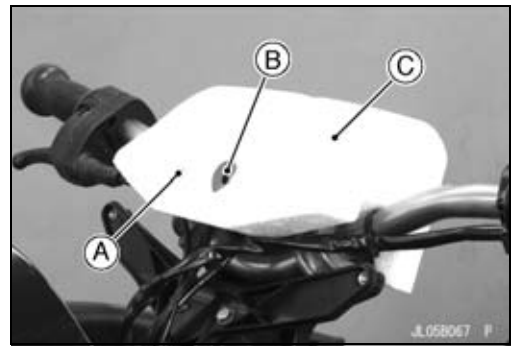
## Handlebars

### *Handlebar Removal*

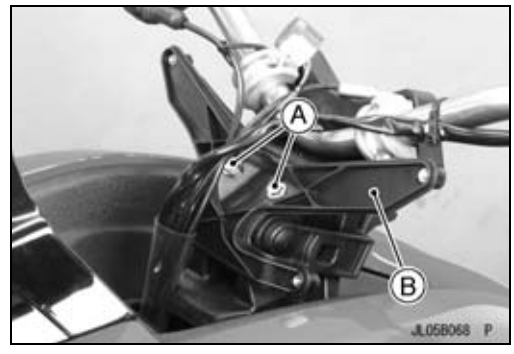
● Remove:
Screws [A]
Handlebar Pad [B]



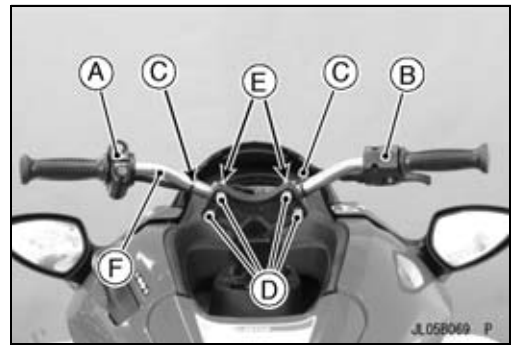

● Remove:
Air Temperature Sensor (for Meter Unit) [A]
Buzzer [B]
Inner Pad [C]




● Remove:
Bolts [A]
Handlebar Pad Holder [B]

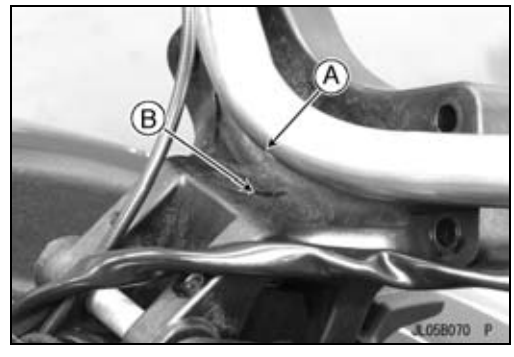



● Remove:
Start/Stop Switch Case [A]
Throttle Case [B]
Bands [C]
Handlebar Clamp Bolts [D]
Handlebar Clamps [E]
Handlebars [F]




### *Handlebar Installation*

● Installation is the reverse of removal. Note the following.
○Align the hole [A] on the handlebars and the line [B] on the steering shaft holder.

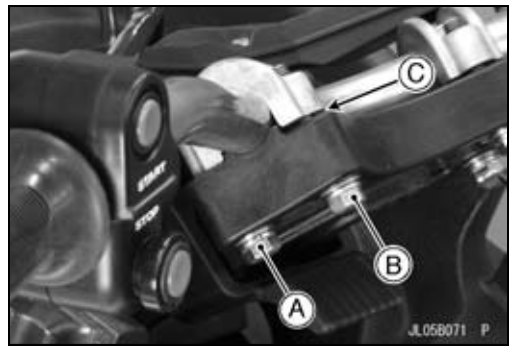


## Handlebars

○Apply a non-permanent locking agent to the handlebar clamp bolts.
○Tighten:

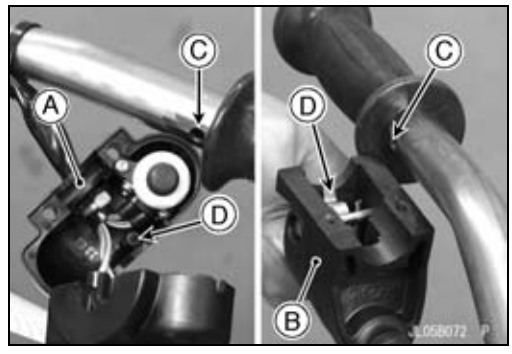
**Torque - Handlebar Clamp Bolts: 15.7 N·m (1.6 kgf·m, 12 ft·lb)**

○Tighten the lower clamp bolt [A] first, and then the upper clamp bolt [B].
○There will be a gap [C] at the upper part of the clamp after tightening.

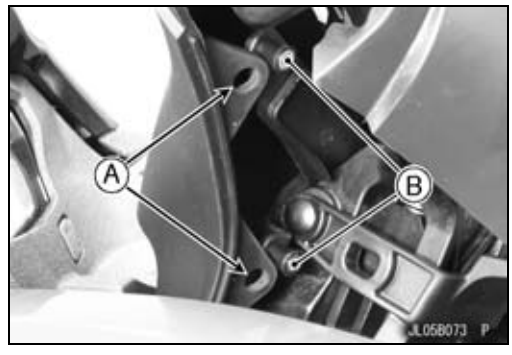



○Run the cable and wires (see Cable, Wire, and Hose Routing section in the Appendix chapter).
○Install the start/stop switch case [A] and the throttle case [B].
○Fit the hole [C] and the projection [D].
○Tighten:

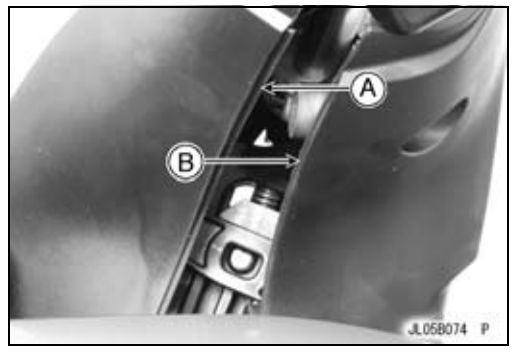
**Torque - Start/Stop Switch Case Mounting Screws: 3.9 N·m (0.40 kgf·m, 35 in·lb)**
**Throttle Case Mounting Screws: 3.9 N·m (0.40 kgf·m, 35 in·lb)**




○Install the handlebar pad.
○Fit the holes [A] and the bosses [B] on both sides.



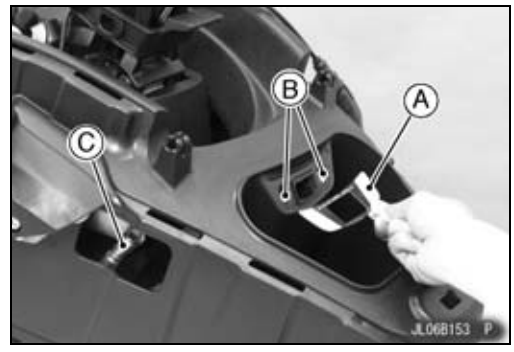

○Align the projection [A] and the groove [B].



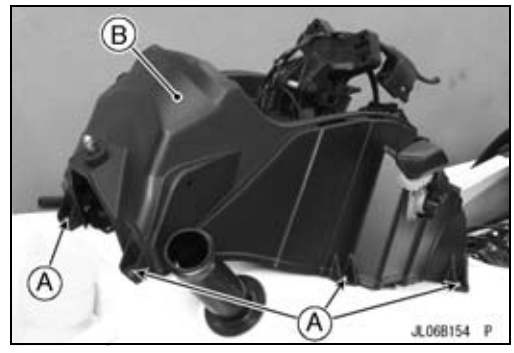
## Steering

### *Steering Removal*

- Remove:
  Center Storage Lid (see Center Storage Lid Removal in the Hull/Engine Hood chapter)
  Side Covers (see Side Cover Removal in the Hull/Engine Hood chapter)
  Handlebars (see Handlebar Removal)
  Plate [A]
  Bolts [B]
- Disconnect the shift cable ball joint [C].

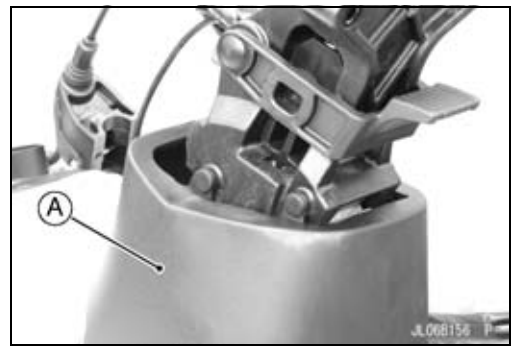



- Remove the steering cover nuts [A] and washers on both sides.
- Take the steering cover [B] off the hull.

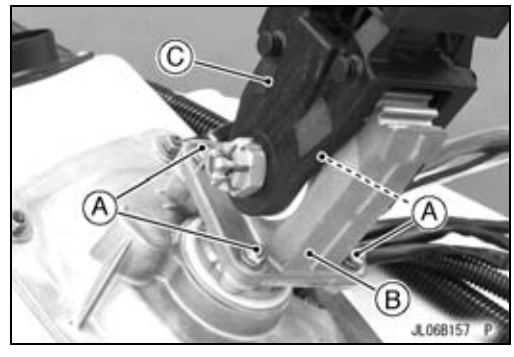



- Open the clamp [A].

- Remove:
  Steering Pad [A]

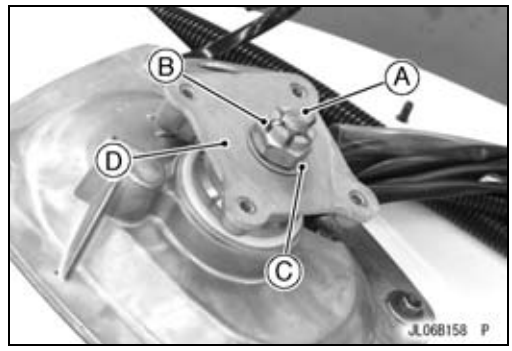



- Remove:
  Steering Neck Mounting Bolts [A]
  Steering Neck [B] with Adjustable Steering Holder [C]

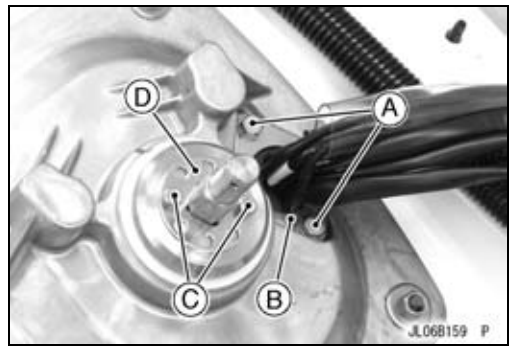


## Steering

- Remove:
  Cotter Pin [A]
  Steering Shaft Locknut [B]
  Washer [C]
  Holder [D]

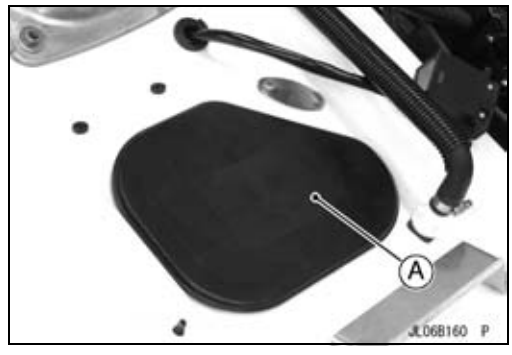



- Remove:
  Grommet Mounting Plate Bolts [A]
  Grommet Mounting Plate [B]
  Lock Plate Mounting Bolts [C]
  Lock Plate [D]

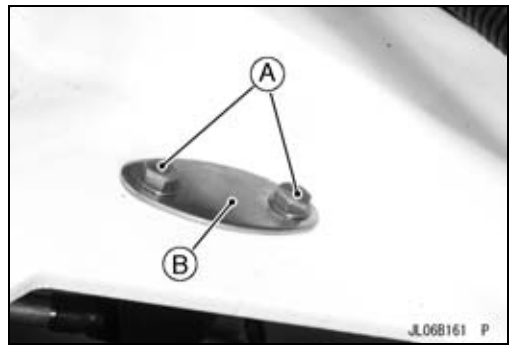



- Disconnect:
  Steering Position Sensor Lead Connector
  Buzzer Lead Connector
  Air Temperature Sensor (for Meter Unit) Lead Connector
  Throttle Case Lead Connectors
  Start/Stop Switch Case Lead Connector
  Throttle Cable Upper End at Throttle Case

- Remove the center access cover [A].

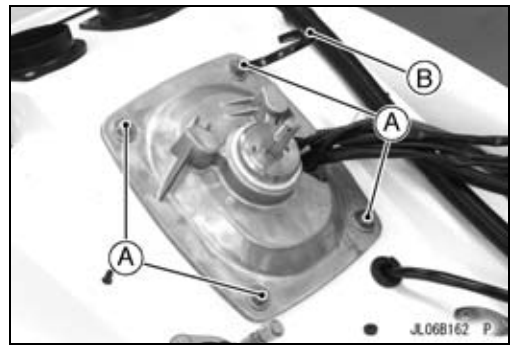



- Remove:
  Steering Cable Bracket Bolts [A]
  Plate [B]



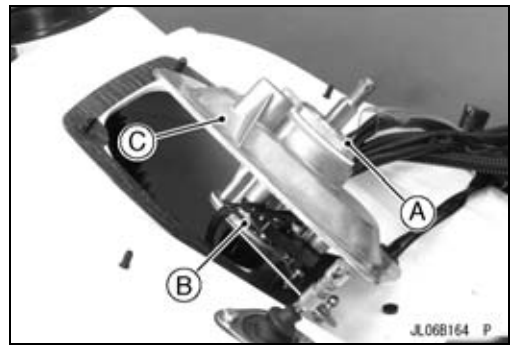
## Steering

- Remove:
  Steering Holder Nuts [A] and Washer
  Clamp [B]
- Raise the steering holder.




- Take the steering cable ball joint [A] off the steering shaft.

- Remove:
  Steering Shaft Nut [A]
  Steering Shaft [B]
  Steering Holder [C]

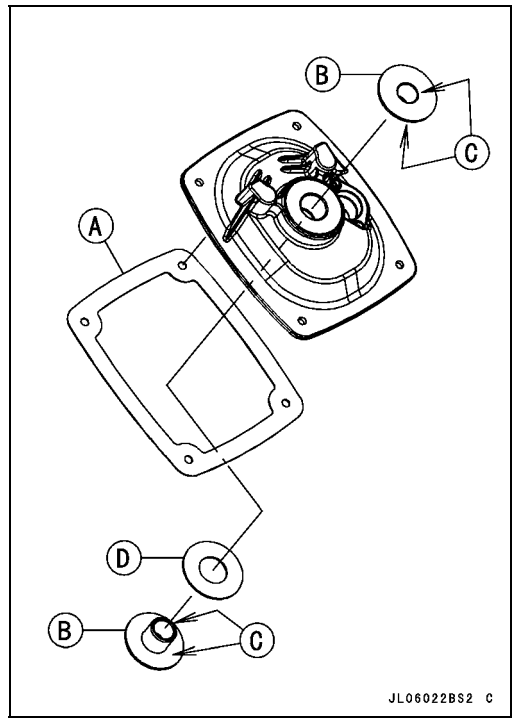



### *Steering Installation*

- Replace the steering holder gasket [A] with a new one.
- Check the bushings [B] for damage and wear.

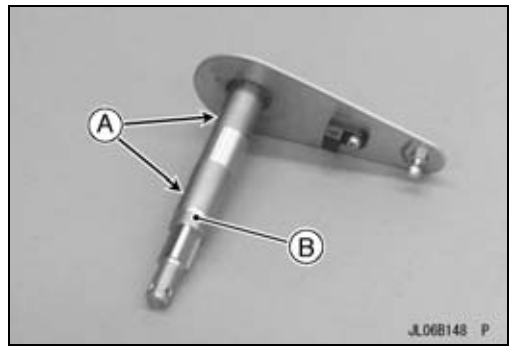
★If the bushings are damaged or worn, replace them with new ones.

- Apply water-resistance grease [C] to the bushings.
- Install the bushings and the washer [D].

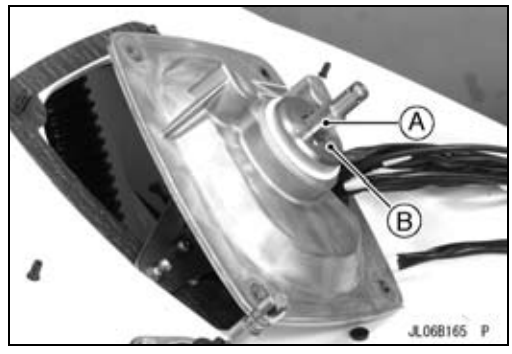


## Steering

- Apply water-resistance grease [A] to the steering shaft [B].




- Install the steering shaft [A].
- Tighten the steering shaft nut [B] by hand, and then loosen.

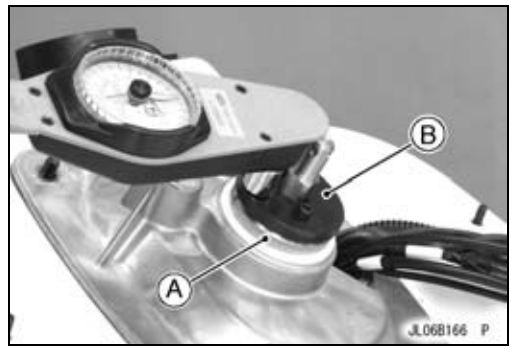



- Tighten the steering shaft nut [A] with the nut tightening plate [B].

  **Special Tool - Nut Tightening Plate: 57001-1698**

○Torque (2.6 N·m, 0.27 kgf·m, 23 in·lb) the plate with nut.

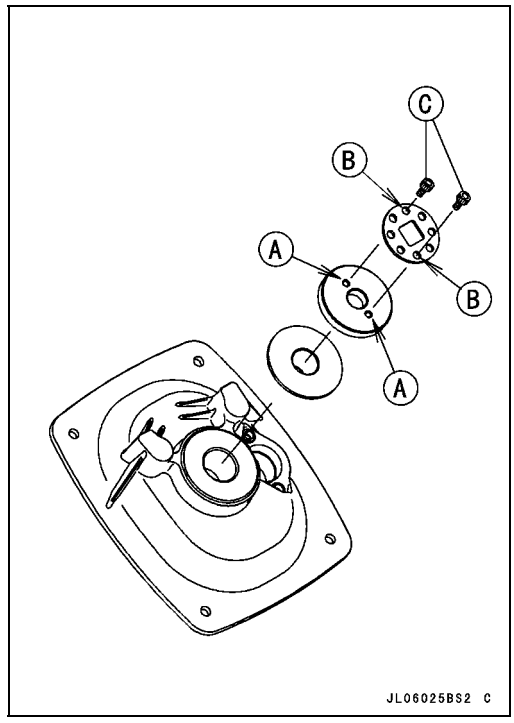
  **Torque - Steering Shaft Nut: 2.9 N·m (0.30 kgf·m, 26 in·lb)**




- Remove the special tool.
- Loosen the steering shaft nut so that the threads [A] of the steering shaft nut are aligned with the holes [B] of the plate within second chance.
- Tighten the bolts [C] and check steering shaft turns freely with no play.
- Inspect the steering position sensor clearance (see Steering Position Sensor Clearance Inspection in the Electrical System chapter).
- Apply water-resistance grease to the joint ball.
- Install the steering cable to the steering shaft.
- Apply a non-permanent locking agent to the steering cable bracket bolts.
- Tighten:

  **Torque - Steering Cable Bracket Bolts: 9.8 N·m (1.0 kgf·m, 87 in·lb)**
  **Steering Holder Mounting Nuts: 19.6 N·m (2.0 kgf·m, 14 ft·lb)**
  **Steering Shaft Locknut: 29.4 ~ 34.3 N·m (3.0 ~ 3.5 kgf·m, 22 ~ 25 ft·lb)**

- Apply a non-permanent locking agent to the grommet mounting plate bolts.
- Install the grommet and the grommet mounting plate.

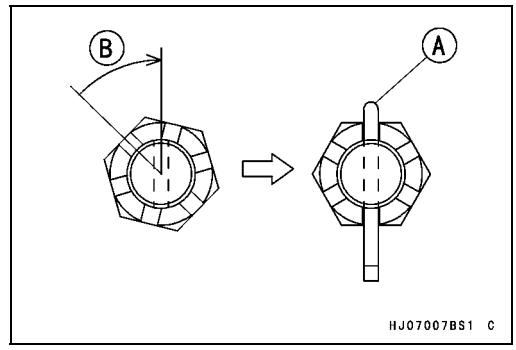


## Steering

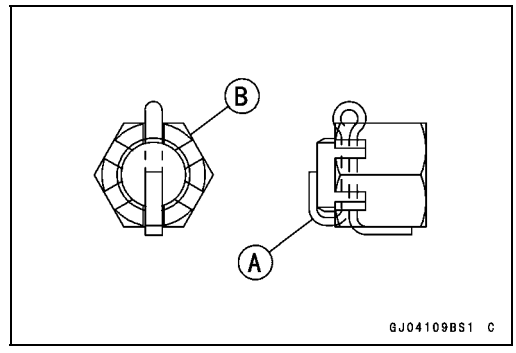
● Insert a new cotter pin [A].

**NOTE**

○*When inserting the cotter pin, if the slots in the nut do not align with the cotter pin hole in the axle, tighten the nut clockwise [B] up to next alignment.*
○*It should be within 30 degrees.*
○*Loosen once and tighten again when the slot goes past the nearest hole.*

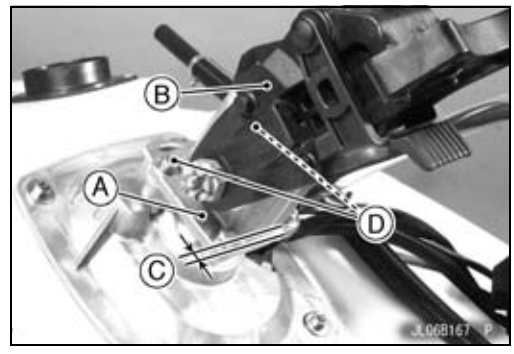



● Bend the cotter pin [A] over the nut [B].




● Install the steering neck [A] with the adjustable steering holder [B] so that its narrow side [C] faces the rear as shown in the figure.
● Apply a non-permanent locking agent to the steering neck mounting bolts [D].
● Tighten:

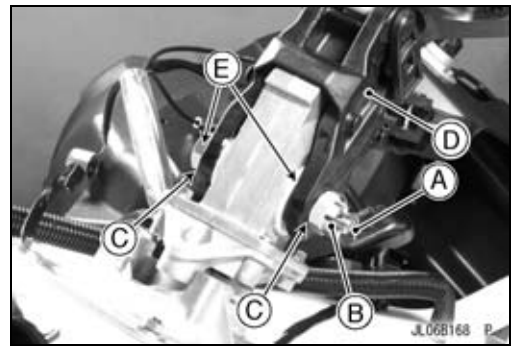
**Torque - Steering Neck Mounting Bolts: 15.7 N·m (1.6 kgf·m, 12 ft·lb)**




● Adjust the steering cable (see Steering Cable Adjustment).
● Install the removed parts (see appropriate chapters).

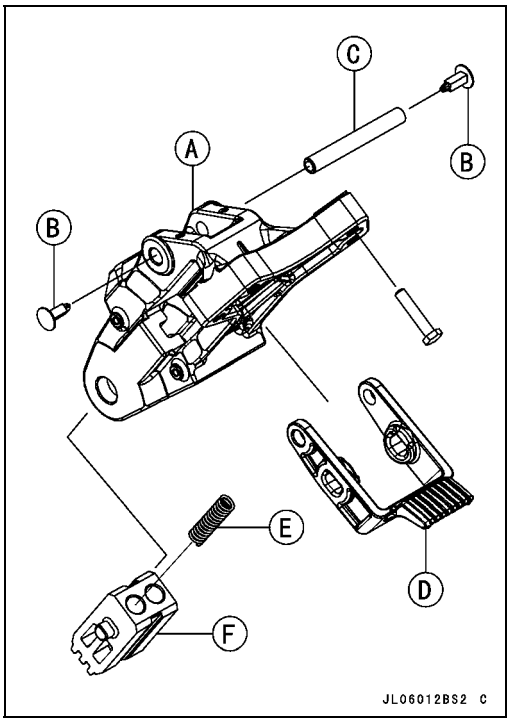
### *Adjustable Steering Holder Disassembly*

● Remove:
Steering Pad (see Steering Removal)
Cotter Pin [A]
Adjustable Steering Holder Nut [B] and Bolt
Washers [C]
Adjustable Steering Holder [D]
Bushings [E]



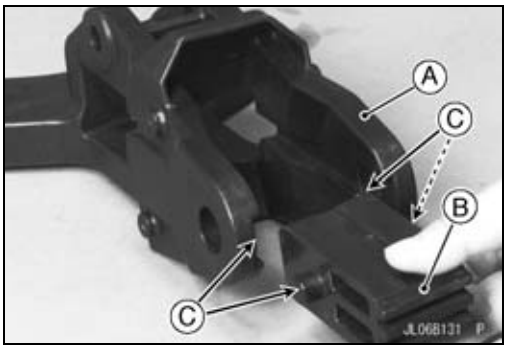
## Steering

● Take the followings off the adjustable steering holder [A].
Rivets [B]
Shaft [C]
Tilt Lever [D]
Springs [E]
Adjustable Rod [F]

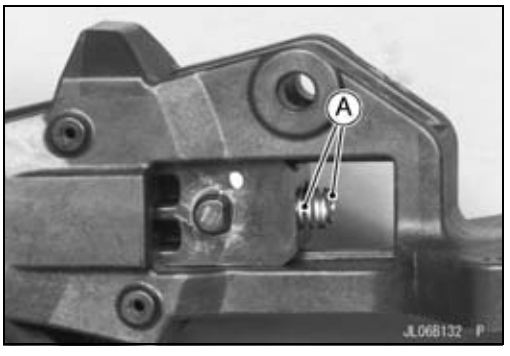



### *Adjustable Steering Holder Assembly*

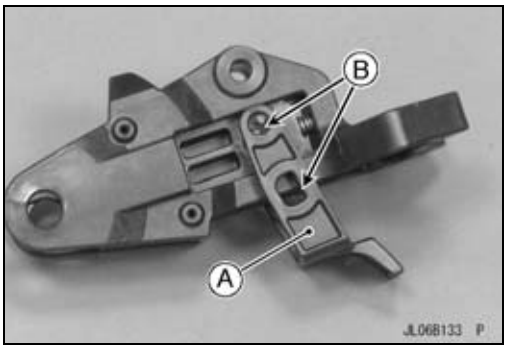
● Insert the adjustable rod [B] into the adjustable steering holder [A].
○Align [C] the projections on the rod with the grooves on the holder.




● Be sure that the springs [A] are in place.

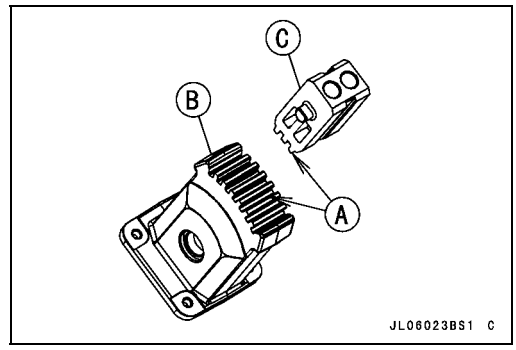



● Install the tilt lever [A] on the adjustable steering holder.
○Align [B] the projection on the adjustable rod with the hole on the tilt lever.



## Steering

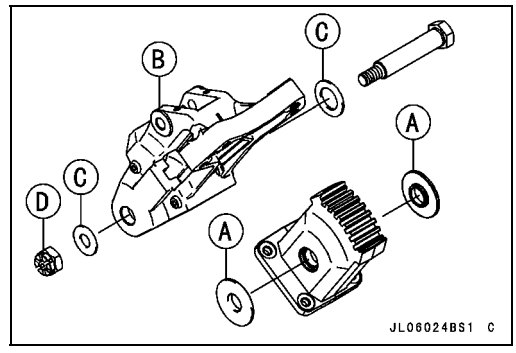
● Apply water-resistance grease [A] to the steering neck [B] and the adjustable rod [C].




● Install:
Bushings [A]
Adjustable Steering Holder [B]
Washers [C]
Adjustable Steering Holder Nut [D] and Bolt

● Tighten:

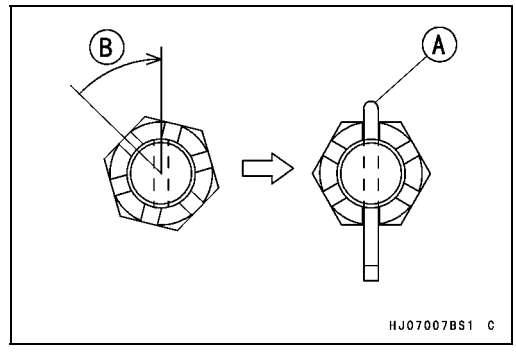
**Torque - Adjustable Steering Holder Nut: 4.9 N·m (0.50 kgf·m, 43 in·lb)**



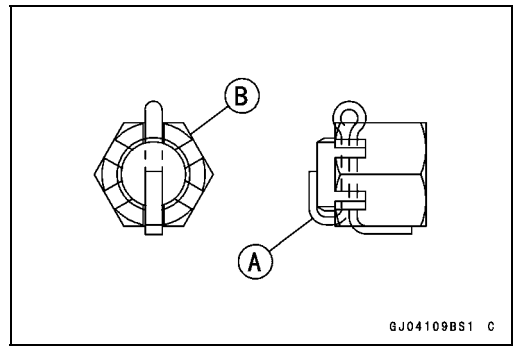

● Insert a new cotter pin [A].

**NOTE**

○*When inserting the cotter pin, if the slots in the nut do not align with the cotter pin hole in the axle, tighten the nut clockwise [B] up to next alignment.*
○*It should be within 30 degrees.*
○*Loosen once and tighten again when the slot goes past the nearest hole.*



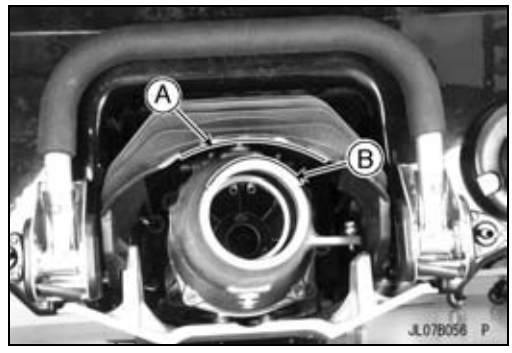

● Bend the cotter pin [A] over the nut [B].



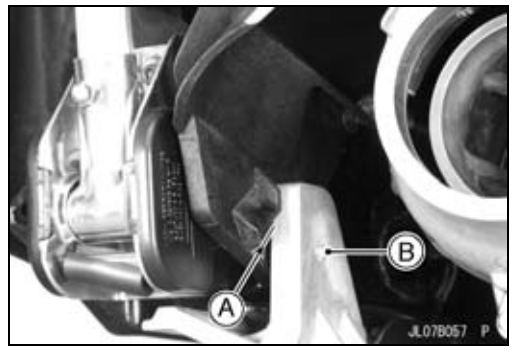
## Reverse System

### *Shift Cable Adjustment*

- Check the shift cable adjustment.
- When the shift lever is in the “F” position, the lower edge [A] of the bucket should be held above the top [B] of the steering nozzle with slight play so it doesn’t interfere with the water flow from the jet pump.

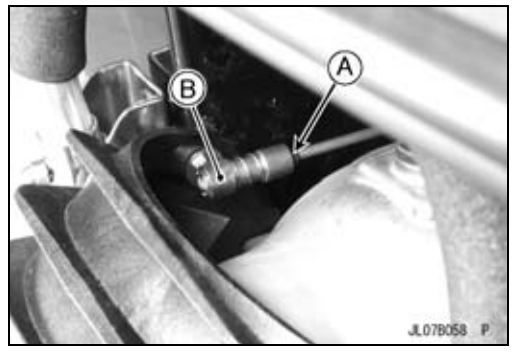



- When the shift lever is in the “R” position, the lower stopper [A] on the bucket should rest against the bottom [B] of the pump cover.



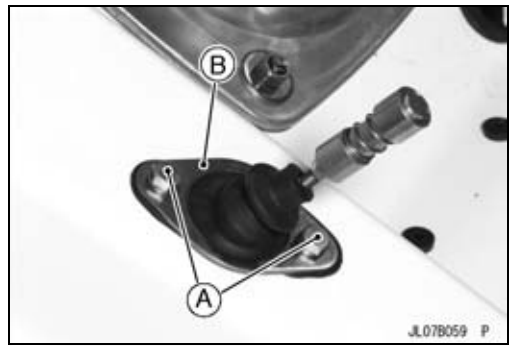

★If either position is incorrect, adjust the shift cable.

- Put the shift lever in the “R” position.
- Loosen the locknut [A] of the shift cable.
- Slide back the outer sleeve and take the ball joint [B] off the ball.
- Turn the ball joint to adjust the shift cable.
- Connect the ball joint and check the cable adjustment again.
- When adjustment is correct, tighten the shift cable locknut.

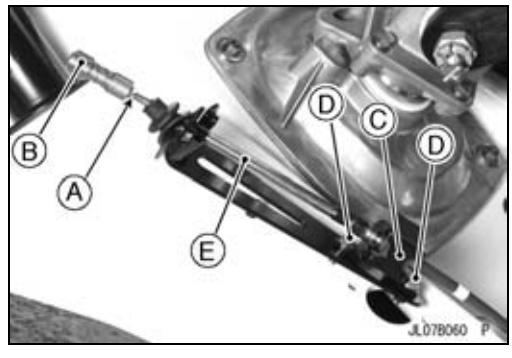



### *Shift Cable Removal*

- Lift up the steering cover (see Steering Removal).
- Remove:
  Plate Bolts [A]
  Plate [B]

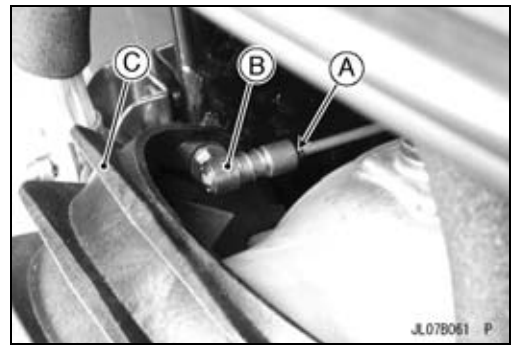



- Loosen the locknut [A] at the front end of the shift cable and take off the ball joint [B], and remove the locknut from the cable front end.
- Take the holder [C] off the cable bracket.
- Remove the cable bracket mounting bolts [D].
- Slide the shift cable [E] off the cable bracket.



## Reverse System

● Loosen the locknut [A] at the rear end of the shift cable, and remove the ball joint [B] from the reverse bucket [C],

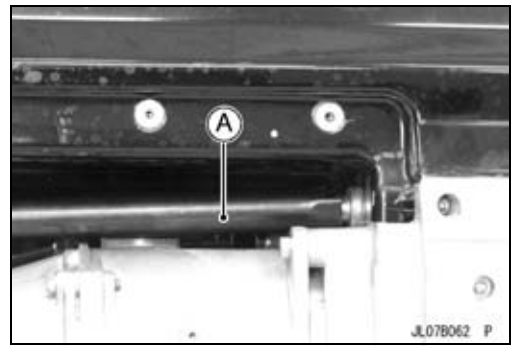



● Unscrew the large nut (shift cable nut) in the hull with the box wrench.

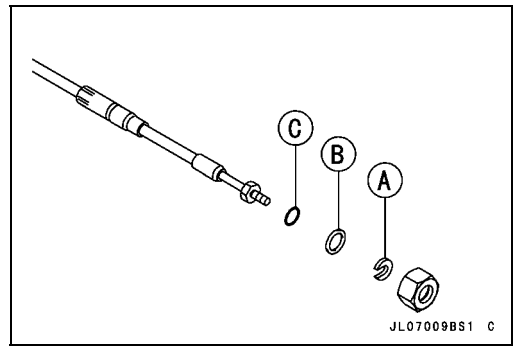
○Special tool, box wrench [A] is useful to remove the large nut (shift cable nut).

**Special Tool - Box Wrench (27 mm): 57001-1749**

○When using the box wrench, avoid bending the shift cable. Such a bend to the cable can damage it.




● Slide off the snap ring [A], washer [B] and O-ring [C].
● Pull out the shift cable toward the rear.




### *Shift Cable Installation*

● Installation is the reverse of removal. Note the following.

○Slide a short piece of rubber or plastic tubing over the front cable end to guide the cable through the hull.

○Lubricate the outside of the new cable to ease cable installation.

○Replace the O-ring with a new one.

○Apply water-resistance grease to the new O-ring.

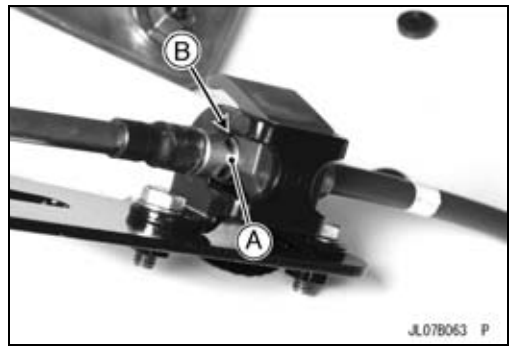
○Tighten the shift cable nut with the box wrench.

**Special Tool - Box Wrench (27 mm): 57001-1749**

**Torque - Shift Cable Nut: 39.2 N·m (4.0 kgf·m, 29 ft·lb)**

## Reverse System

○Engage the groove [A] on the steering cable with the opening portion [B] on the cable bracket as shown.
○Apply water-resistance grease to the joint ball at each end of shift cable.
○Adjust the shift cable (see Shift Cable Adjustment).




### *Shift Cable Inspection*

● Refer to the Steering Cable/Shift Cable Inspection in the Periodic Maintenance chapter.

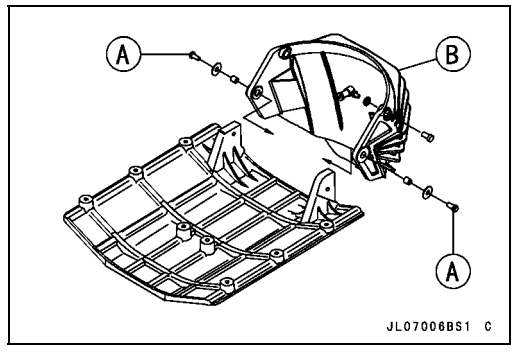
### *Shift Cable Lubrication*

**NOTE**

○*The shift cable is sealed at each end and do not require lubrication. If the seal is damaged, the cable must be replaced.*

### *Reverse Bucket Removal/Installation*

● Disconnect the ball joint at rear end of the shift cable.
● Remove the pump cover (see Pump Removal in the Pump/Impeller chapter).
● Unscrew the pivot bolts [A] and remove the reverse bucket [B].



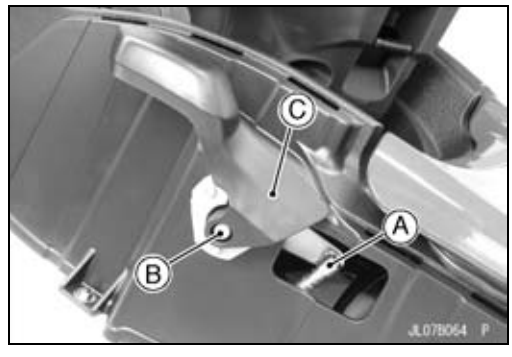

● Installation is the reverse of removal. Note the following.
○Apply a non-permanent locking agent (High Strength: Loctite 271 equivalent) to the reverse bucket pivot bolts, and torque them.

**Torque - Reverse Bucket Pivot Bolts: 19 N·m (1.9 kgf·m, 14 ft·lb)**

○After installation, check the shift cable adjustment (see Shift Cable Adjustment).

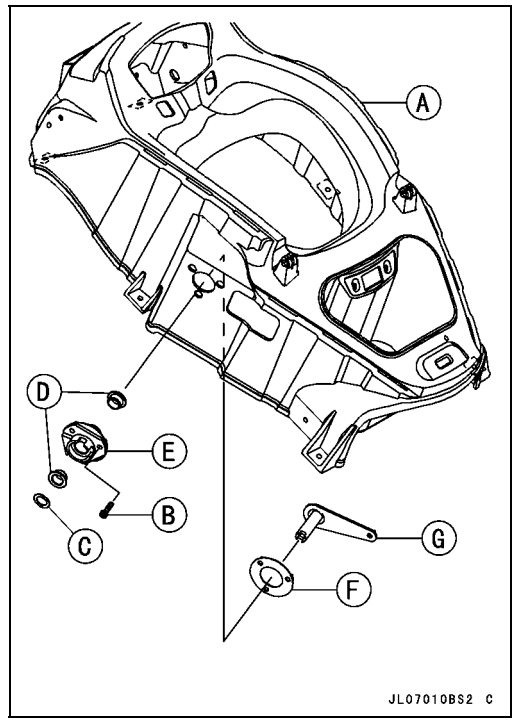
### *Shift Lever Shaft Removal/Installation*

● Remove the side covers (see Side Cover Removal in the Hull/Engine Hood chapter).
● Disconnect the shift cable ball joint [A] at upper end.
● Unscrew the shift lever bolt [B] and remove the shift lever [C].



## Reverse System

- Lift up the steering cover [A] (see Steering Removal).
- Remove:
  Bolts [B]
  Washer [C]
  Collars [D]
  Shift Lever Holder [E]
  Shift Lever Bracket [F]
  Shift Lever Shaft [G]

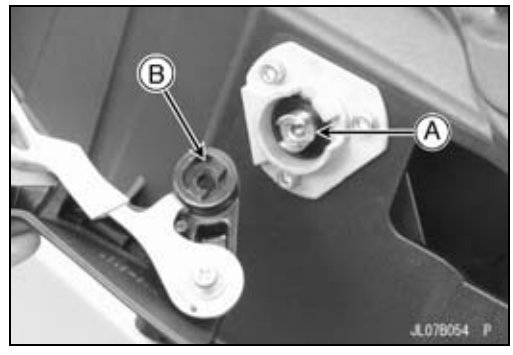



- Installation is the reverse of removal. Note the following.

○Align the slot [A] on the shift lever shaft with the projection [B] on the shift lever.

○Apply a non-permanent locking agent (Hight Strength: Loctite 271 equivalent) to the shift lever bolt.

○Before connecting the shift cable, apply a water-resistance grease to its joint ball.




○Inspect the reverse lever [A] is properly locked [B] to forward.

○Adjust the position if necessary (see Shift Cable Adjustment).

# Hull/Engine Hood

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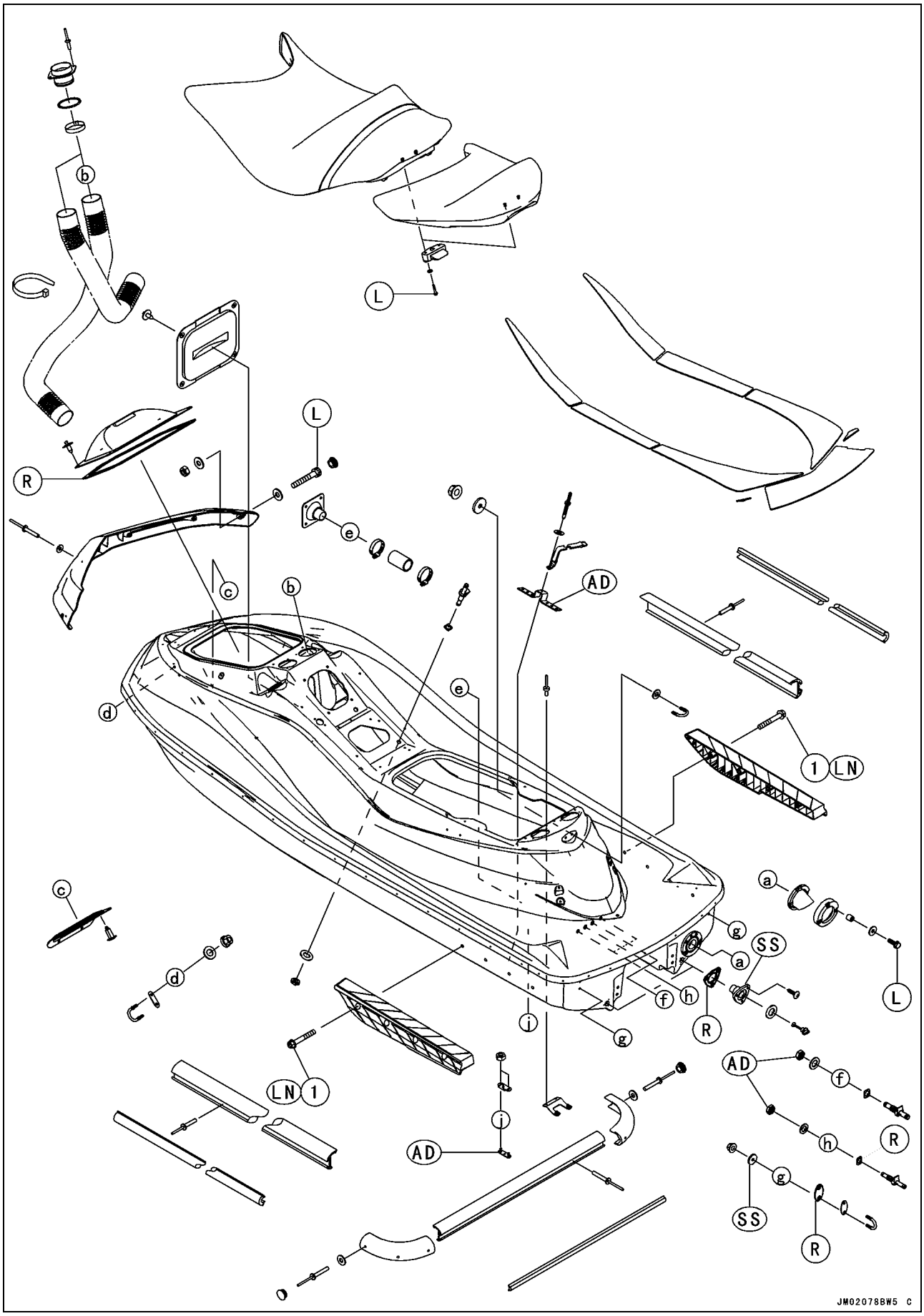
## Exploded View

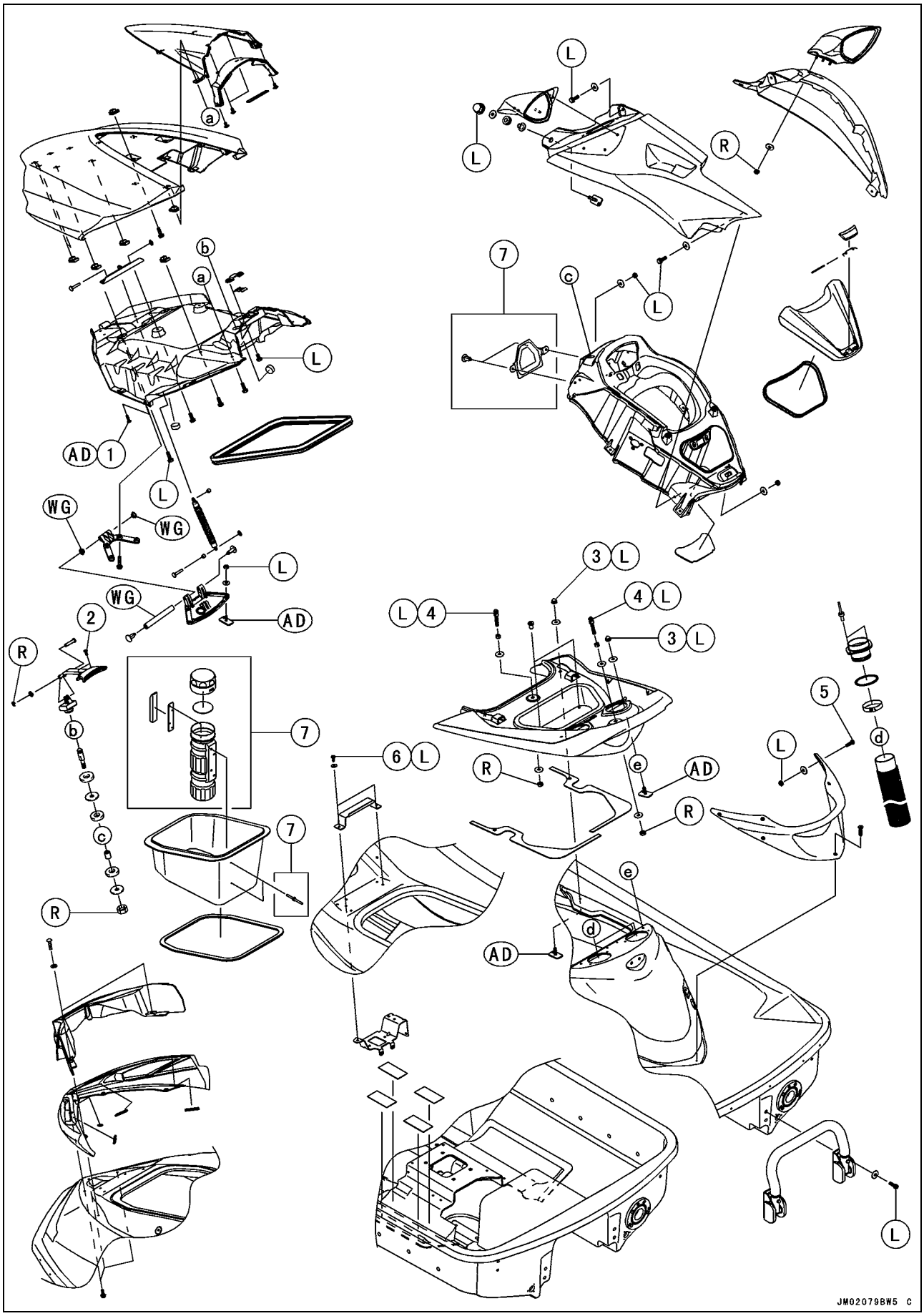


## Exploded View

| No. | Fastener | Torque | | | Remarks |
|---|---|---|---|---|---|
| | | N·m | kgf·m | ft·lb | |
| 1 | Stabilizer Bolts | 15.7 | 1.6 | 12 | LN |

AD: Apply adhesive.
LN: Apply a non-permanent locking agent.(High Strength: Loctite 271 equivalent).
R: Replacement Parts
SS: Apply silicone sealant.

## Exploded View



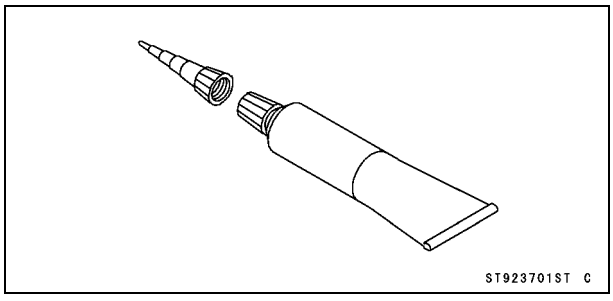
## Exploded View

| No. | Fastener | Torque | | | Remarks |
|---|---|---|---|---|---|
| | | N·m | kgf·m | ft·lb | |
| 1 | Front Hatch Mounting Screws | 2.0 | 0.20 | 18 in·lb | AD |
| 2 | Latch Handle Screws | 2.0 | 0.20 | 18 in·lb | |
| 3 | Handrail Plate Nuts | 9.8 | 1.0 | 87 in·lb | L |
| 4 | Seat Lock Ratchet Pins | 27 | 2.8 | 20 | L |
| 5 | Handrail Mounting Screws | 4.0 | 0.41 | 35 in·lb | |
| 6 | Bracket Bolts | 8.8 | 0.90 | 78 in·lb | L |

7. US and EUR Models
AD: Apply adhesive.
G: Apply grease.
L: Apply a non-permanent locking agent.
R: Replacement Parts
SS: Apply silicone sealant.
WG: Apply water resistance grease.

## Sealant

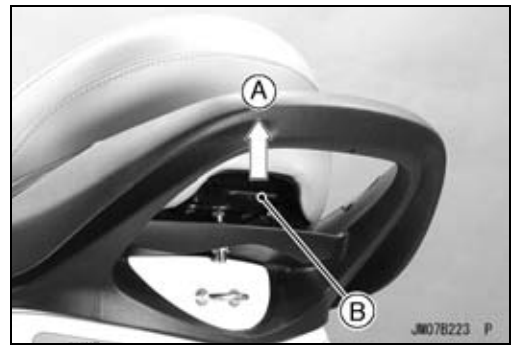
**Adhesive, TB1521:**
**92104-3701**



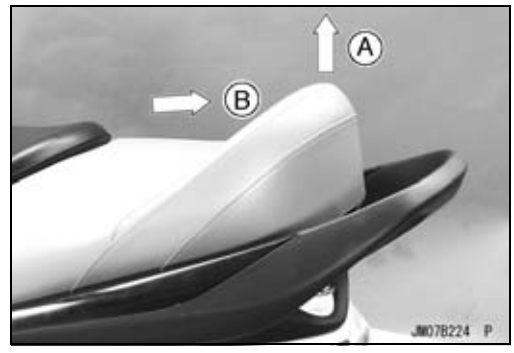
## Fittings

### *Seat Removal*

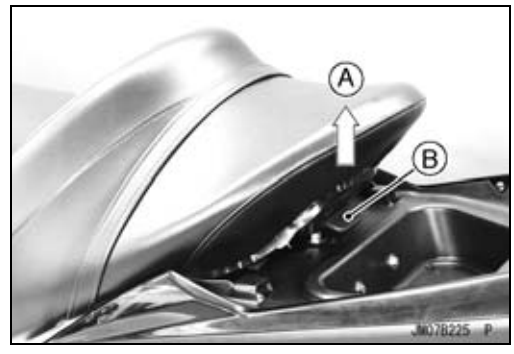
- Pull up [A] the latch handle [B].



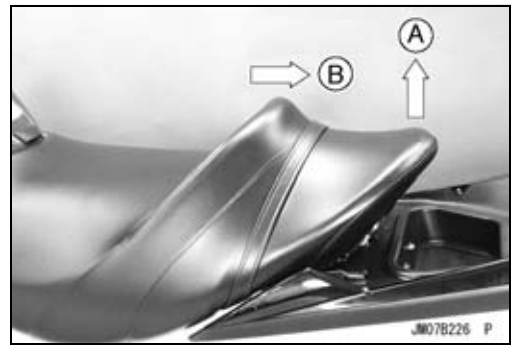

- Remove the rear seat up [A] and to the rear [B].




- Pull up [A] the latch handle [B].

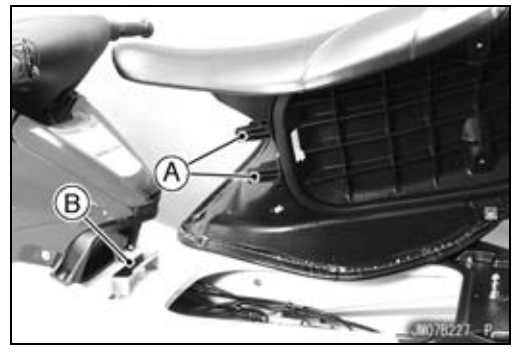



- Remove the front seat up [A] and to the rear [B].



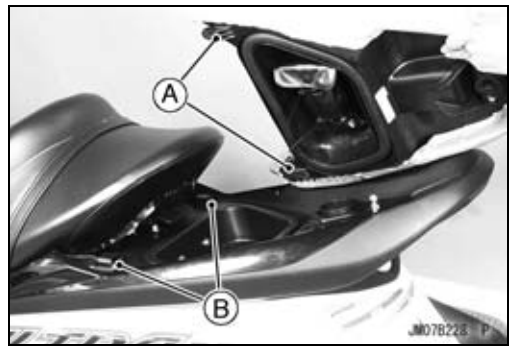

### *Seat Installation*

- Insert the seat hooks [A] into the bracket [B] on the deck and slide it all the way forward by pushing the rear of the seat.
- Push down on the rear of the seat to lock it.



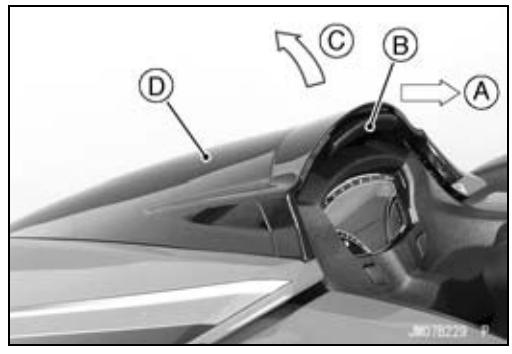
## Fittings

- Insert the seat hooks [A] into the brackets [B] on the handrail plate and slide it all the way forward by pushing the rear of the seat.
- Push down on the rear of the seat to lock it.

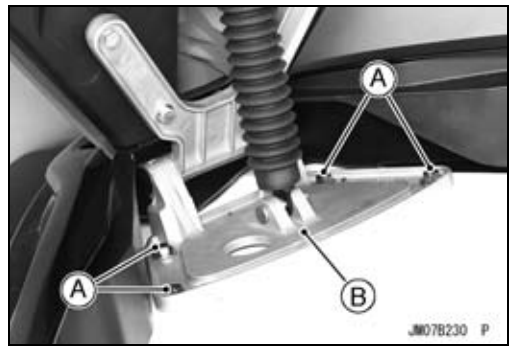



### *Front Storage Compartment Cover Removal/Installation*

- Pull [A] the latch handle [B].
- Open [C] the front storage compartment cover [D].

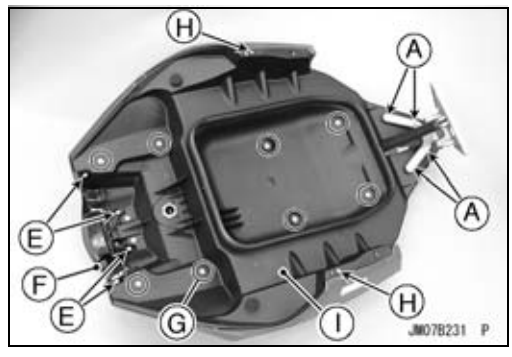


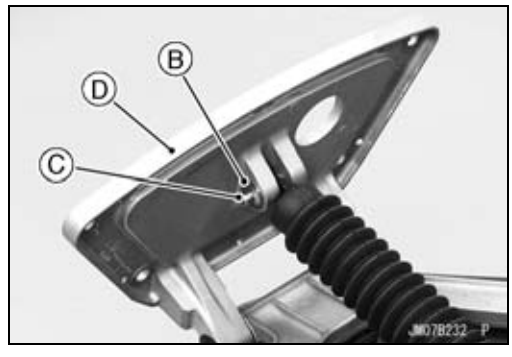

- Remove:
  Hinge Bracket Nuts [A] and Washers
  Front Storage Compartment Cover Assembly [B]
- Installation is the reverse of removal.




### *Front Storage Compartment Cover Disassembly*

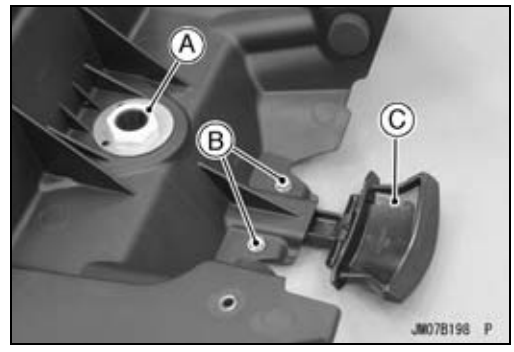
- Remove:
  Hinge Bolts [A]
  Damper Washer [B]
  Damper Pin [C]
  Hinge [D]
  Screws [E]
  Meter Cover [F]
  Front Duct Bolts [G]
  Front Hatch Mounting Screws [H]
  Front Duct [I]



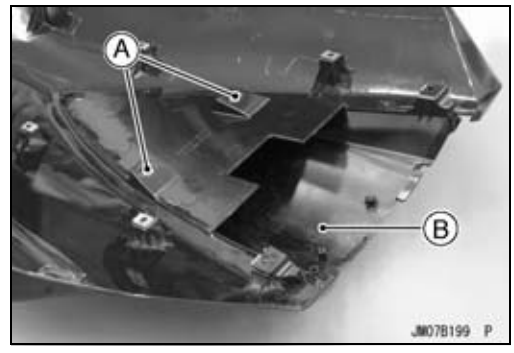



## Fittings

- Remove:
  Lock Assembly Nut [A]
  Lock Assembly Bolts [B]
  Bracket
  Lock Assembly [C]

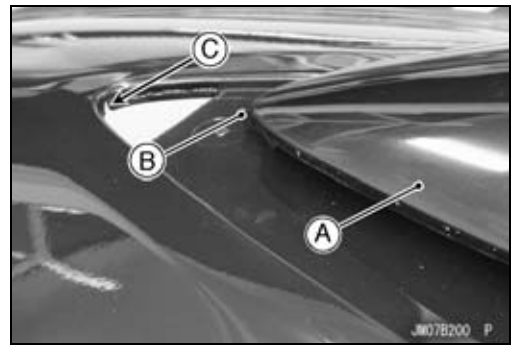



- Remove:
  Screen Bolts [A]
  Screen [B]

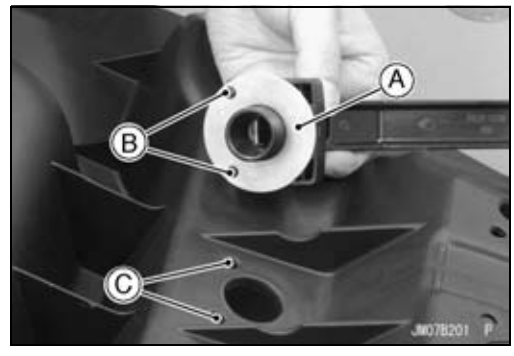



### *Front Storage Compartment Cover Assembly*

- When installing the screen [A] on the front storage compartment cover, insert its projection [B] into the recess [C] on the front storage compartment cover.
- Apply a non-permanent locking agent to the screen bolts and tighten them securely.



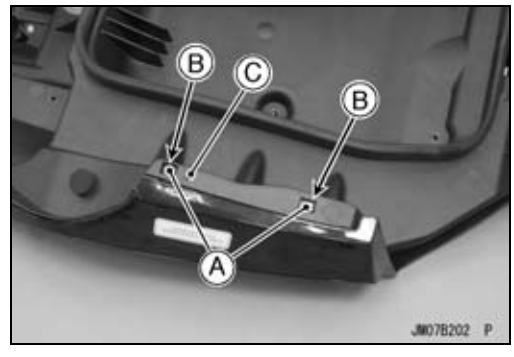

- Install the washer [A] on the lock assembly.
- Align the projections [B] on the lock assembly with the holes [C] on the front duct.
- Apply a non-permanent locking agent to lock assembly bolts and tighten them securely.
- Tighten the lock assembly nut.




- Insert the front storage cover projections [A] into the ribs [B] of the front duct.
- Tighten the front hatch mounting screws [C] (both sides).

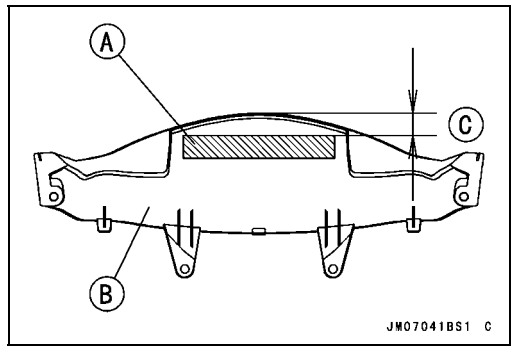
**Torque - Front Hatch Mounting Screws: 2.0 N·m (0.20 kgf·m, 18 in·lb)**

- Apply a non-permanent locking agent to the front duct bolts and tighten them securely.

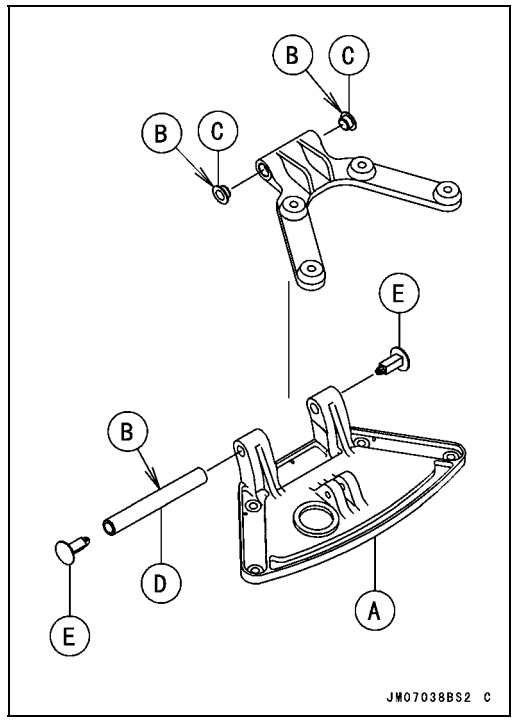


## Fittings

- Install the damper [A] on the meter cover [B], and install the meter cover.
  15 mm (0.59 in.) [C]

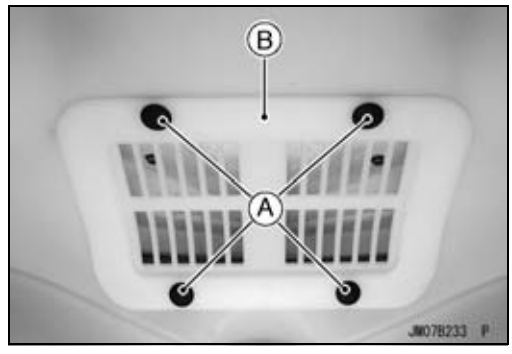



○If the hinge bracket [A] is disassembled, apply a water -resistance grease [B] to the following.
  Bushings [C]
  Shaft [D]
○Replace the rivets [E] with new ones.



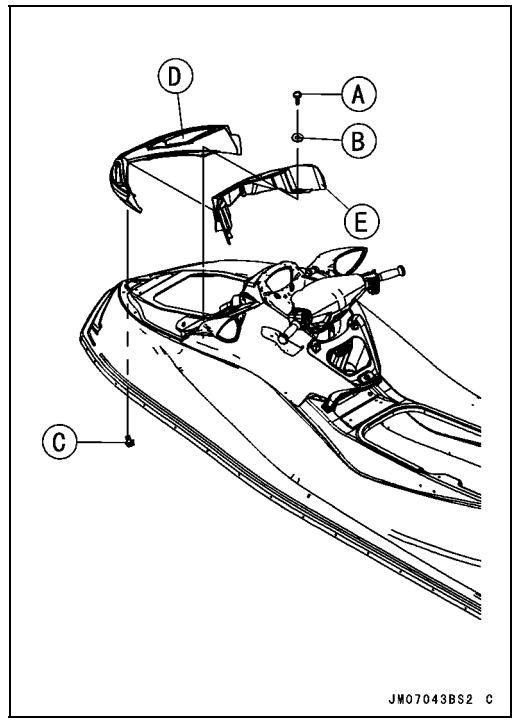

### *Front Cover Removal/Installation*

- Remove:
  Front Storage Compartment Cover (see Front Storage Compartment Cover Removal/installation)
- Push in the pins [A] and remove the cover [B].

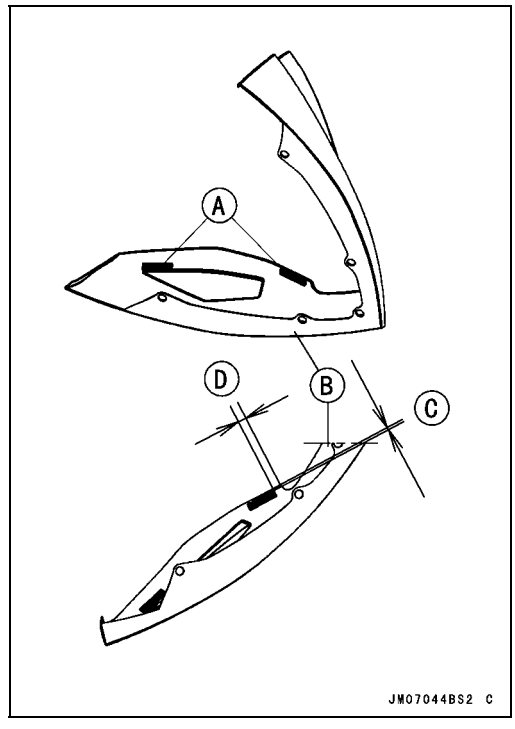


## Fittings

● Remove:
Screws [A]
Washers [B]
Bolts [C]
Front Cover [D]
Front Inner Cover [E]
○Be careful not to drop the bolts.

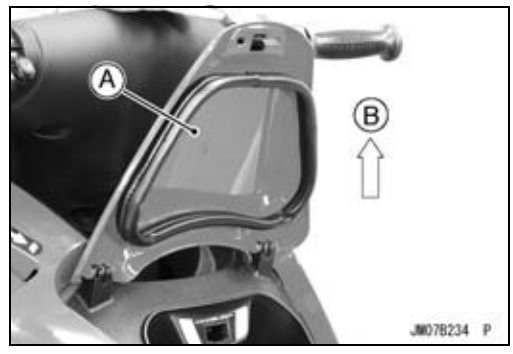



● Installation is the reverse of removal. Note the following.
○Install the dampers [A] on the front cover [B] as shown in the figure.
5 mm (0.20 in.) [C]
15 mm (0.59 in.) [D]



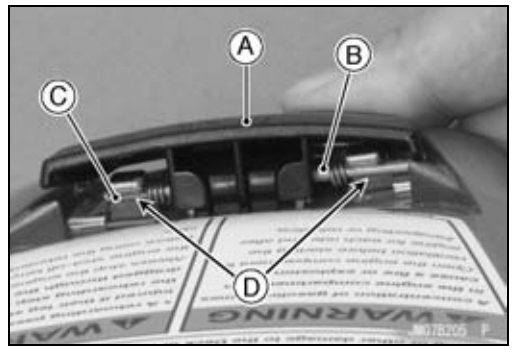

### *Center Storage Lid Removal/Installation*

● Open the middle storage lid [A].
● Pull up [B] the lid.
● Installation is the reverse of removal.



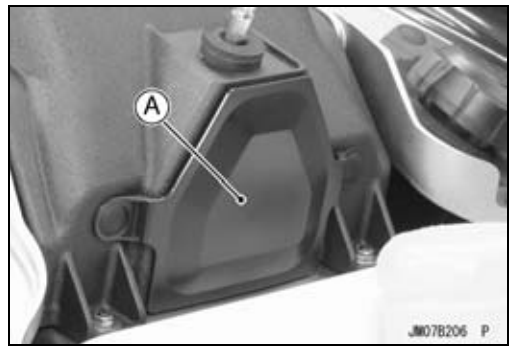
## Fittings

- To remove the lock [A] from the center storage lid, turn and pull out the shaft [B] (both sides).
- When installing the shafts, push the shaft end [C] (both sides) into the hollows [D] on the lock.

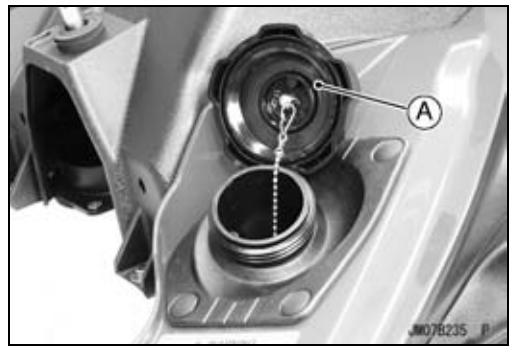



### *Side Cover Removal*

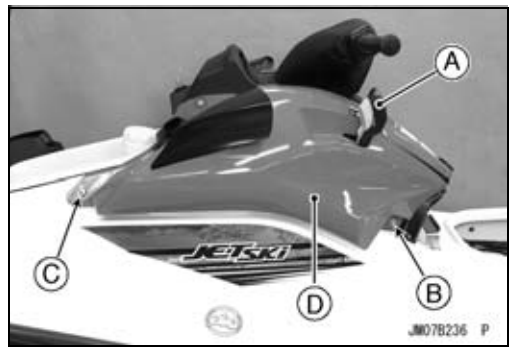
- For US and EUR models, remove the steering front cover [A].



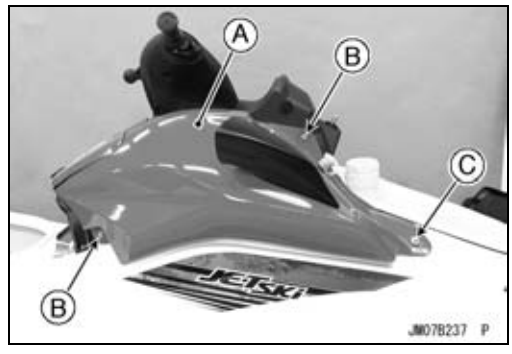

- To remove the left side cover, remove the following.
- Remove the fuel filler cap [A].




- Pull up the shift lever [A].
- Remove:
  Bolts [B], Nuts and Washers
  Nut [C] and Washer
  Left Side Cover [D]

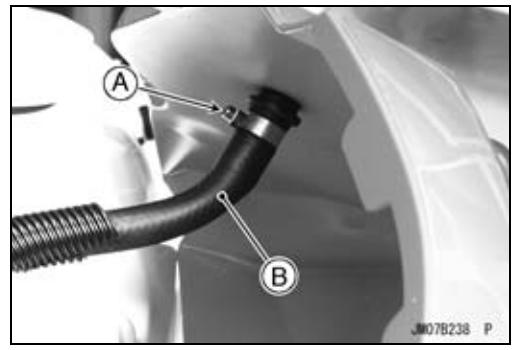



- To remove the right side cover [A], remove the following.
  Center Storage Lid (see Center Storage Lid Removal/Installation)
  Bolts [B], Nuts and Washers
  Nut [C] and Washer



## Fittings

- Loosen the clamp screw [A].
- Remove the flushing hose [B].



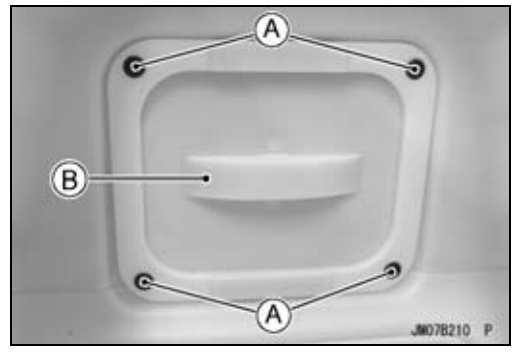

### *Side Cover Installation*

- Installation is the reverse of removal, noting the following.

○Be sure that the rear end of flushing line is connected with its fitting surely.

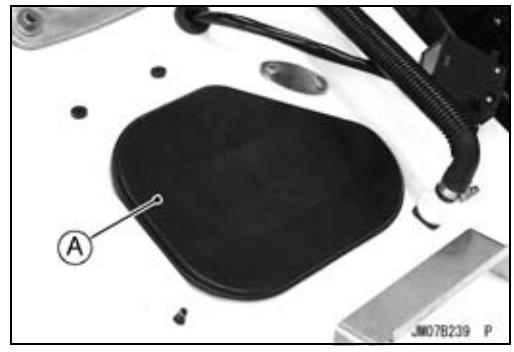
### *Front Access Cover Removal/Installation*

- Open the front storage compartment cover.
- Remove the front storage case.
- Push in the pins [A] and remove the front access cover [B].
- Installation is the reverse of removal.



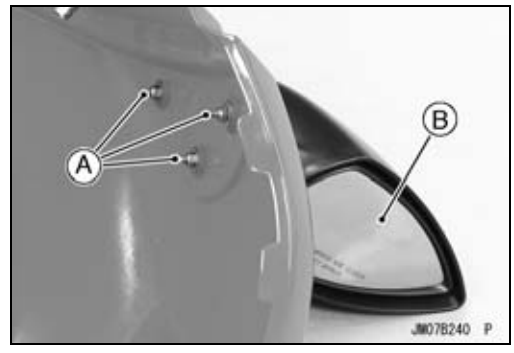

### *Center Access Cover Removal/Installation*

- Remove the steering cover (see Steering Removal in the Steering chapter).
- Pull out the center access cover [A].
- Installation is the reverse of removal.




### *Mirror Removal/Installation*

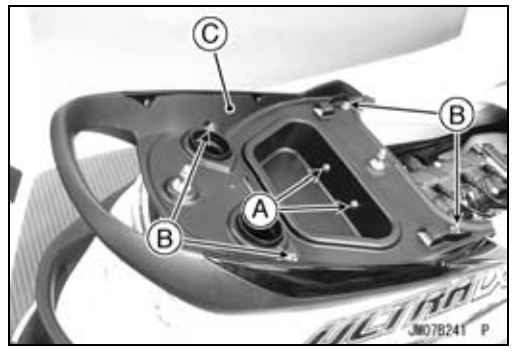
- Remove the side cover (see Side Cover Removal).
- Remove the nuts [A] and washers and remove the mirrors [B] (both sides).
- Installation is the reverse of removal.



## Fittings

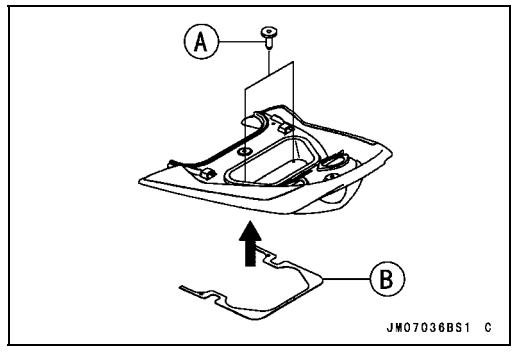
### *Handrail Plate Removal*

- Remove the rear and front seats (see Seat Removal).
- Remove the handrail plate bolts [A], handrail plate nuts [B], washers and remove the handrail plate [C].



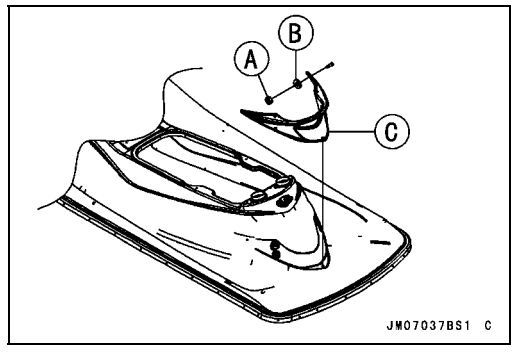

### *Handrail Plate Installation*

- Be sure that the plugs [A] and the damper [B] are in position.



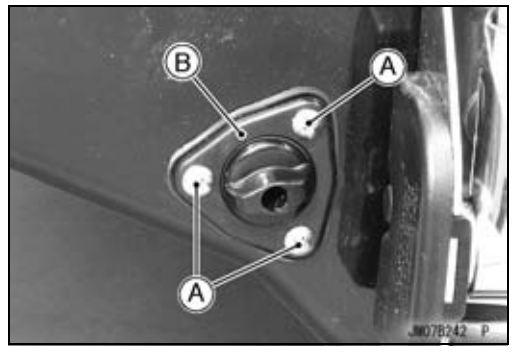

### *Handrail Removal/Installation*

- Remove the rear and front seats (see Seat Removal).
- Disconnect the bilge hoses from the breather fitting.
- Remove the rear air ducts (see Air Duct Removal).
- Remove the nuts [A] and washers [B], and remove the handrail [C].




### *Drain Plug Housing Removal*

- Remove the screws [A] and remove the drain plug housing [B].

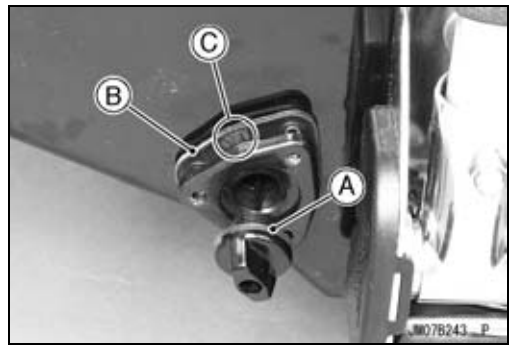



### *Drain Plug Housing Installation*

- Check the seal [A] for damage.

★If necessary, replace it with a new one.

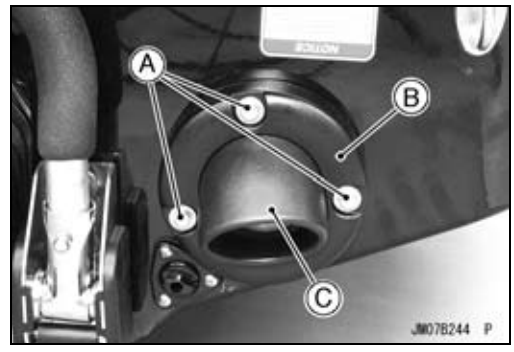
○Install the new gasket [B] so that its “OUT” mark [C] faces outwards.



## Fittings

### *Exhaust Outlet Removal*

- Remove the mounting bolts [A] and washers, and remove the holder [B] and exhaust outlet [C].

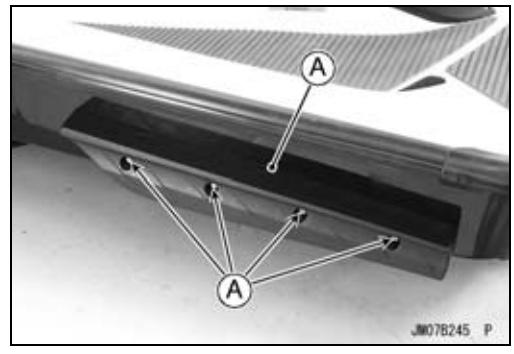



### *Exhaust Outlet Installation*

- Installation is the reverse of removal.
- Apply a non-permanent locking agent to the mounting bolts and tighten them securely.

### *Stabilizer Removal*

- Remove:
  Stabilizer Bolts [A]
  Stabilizer [B]



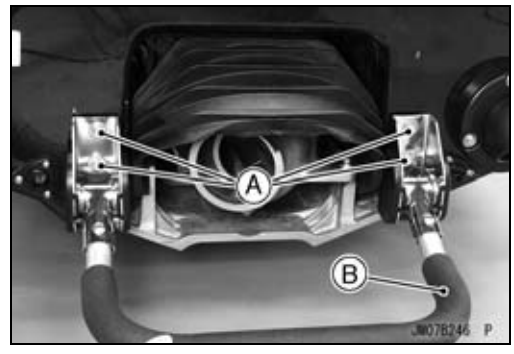

### *Stabilizer Installation*

- Installation is the reverse of removal.
- Apply a non-permanent locking agent (High Strength: Loctite 271 equivalent) to the stabilizer bolt and tighten them.

**Torque - Stabilizer Bolts: 15.7 N·m (1.6 kgf·m, 12 ft·lb)**

### *Reboarding Step Removal*

- Remove the reboarding step bolts [A] and washers, and remove the reboarding step [B].




### *Reboarding Step Installation*

- Installation is the reverse of removal.
- Apply a non-permanent locking agent to the reboarding step bolts and tighten them securely.

## Hull Replacement

To replace the hull, remove the various parts in the following suggested order.

Battery and Pad
Exhaust Pipe
Intake Manifold
Engine and Mounts
Air Filter
Water Box Muffler
Drive Shaft and Shaft Holder
Pump and Hoses
Steering Cover
Handlebar and Steering
Steering Cable
Reverse Cable
Fuel Tank and Filler
Bilge and Cooling System Hose
Bypass Hose and Outlet
Bumpers
Engine Hood Latch
Front Storage Compartment Cover and Brackets
Air Ducts
Handrail

The following parts cannot be removed from the hull and must be replaced.

Decals
Labels
Mats
Registration Number (if any)

If the new hull is to be painted, do that first. Then install removed parts in the reverse order of their removal. Finally, install the labels, decals, mats and the registration numbers.

## Rubber Parts

**NOTE**

○*The rubber parts on the watercraft are fastened in place with various adhesives. To replace a rubber part, use a cement in the following table, or an equivalent.*

**⚠ WARNING**

**Many solvents and adhesives are flammable, may be harmful to the skin and eyes, and may emit harmful vapors. Read all product warnings before use. Use only in a well-ventilated area and never near an open flame.**

| For this Application | Type |
|---|---|
| Mats<br>Front and Rear Seats Gasket<br>Front Storage Compartment Cover Gasket | Synthetic Rubber Adhesive (P/N: 92104-3701) |
| Detent<br>Handlebar Grips | Cyanoacrylate Cement |

***NOTICE***

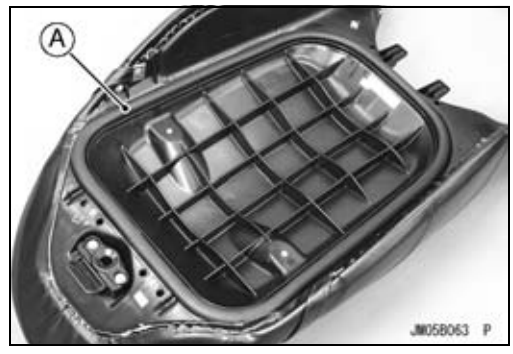
**When the cement cures it may be impossible to reposition the part. Be very careful that the part is positioned correctly when you apply the cement.**

**⚠ WARNING**

**Cyanoacrylate cement is harmful to the eyes and makes skin immediately stick to anything touched. To prevent contact with cyanoacrylate cement, always wear safety goggles and gloves. If there is eye contact, do not try to wash it out -- immediately contact a physician. In case of skin contact, do not touch any other part of your body; allow the cement to cure and it will eventually wear off.**

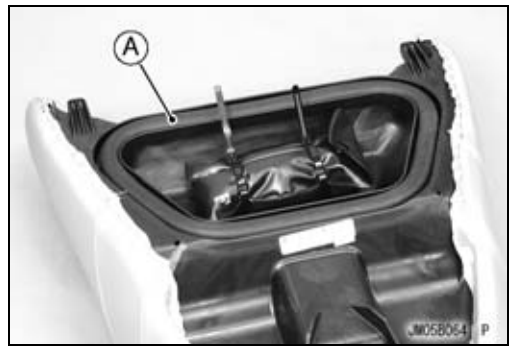
### *Rubber Parts Location*

Front Seat Gasket [A]

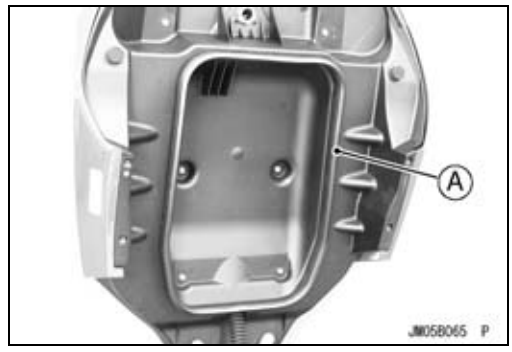


## Rubber Parts

Rear Seat Gasket [A]

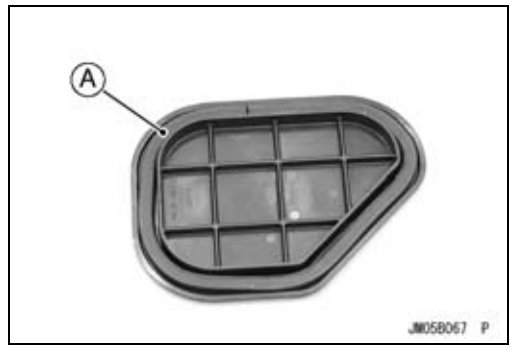



Front Storage Compartment Gasket [A]

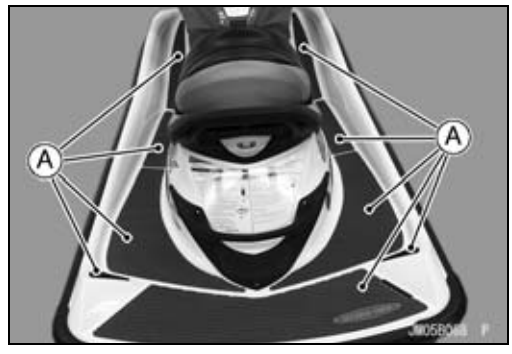



Center Storage Compartment Gasket [A]

Center Access Cover Gasket [A]

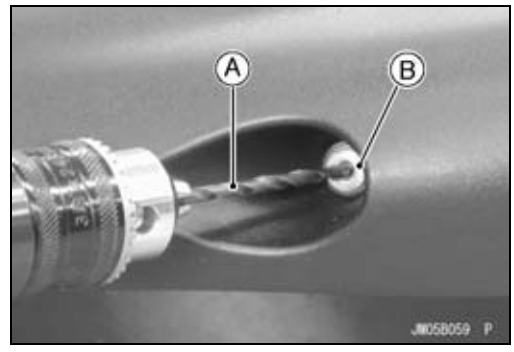



Mats [A]



## Rubber Parts

### *Blind Rivet Removal*



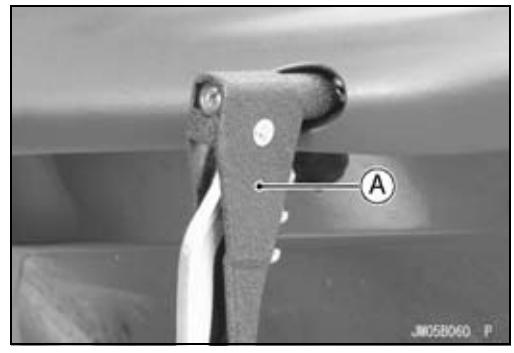

- Drill out the rivet with a drill bit [A] of the correct size.

**Rivet Removal Drill Bit Size**
**5.0 mm (0.2 in.)**

**NOTE**

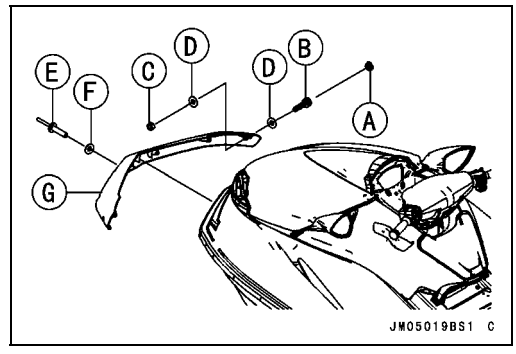
○*Stop drilling when the rivet head [B] starts to turn with drill bit.*
○*Tap the rivet out with a suitable punch and hammer.*

### *Blind Rivet Installation*




- Secure the parts to the hull with the rivets using a blind rivet fastening tool [A].

### *Front Bumper Removal*

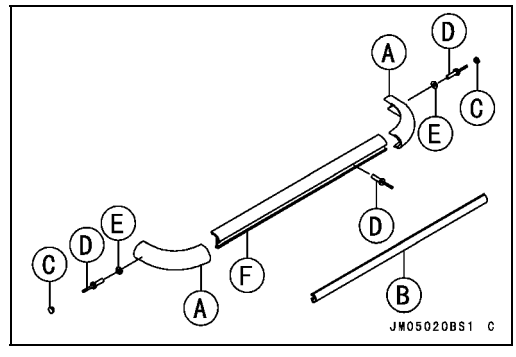



- Remove the plugs [A].
- Remove the mounting bolts [B], nuts [C] and washers [D].
- Drill out the rivets [E] and washers [F] (see Blind Rivet Removal).
- Remove the front bumper [G].

### *Front Bumper Installation*

- Secure the front bumper to the hull flange with the rivets (see Blind Rivet Installation).

### *Rear Bumper Removal*




- Remove the corner bumpers [A] and trim strip [B].
○Remove the plugs [C].
○Drill out the rivets [D] and washers [E] (see Blind Rivet Removal).
- Remove the rear bumper [F].

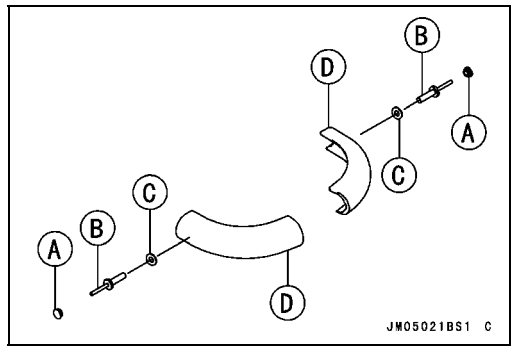
### *Rear Bumper Installation*

- Secure the bumpers to the hull flange with the rivets (see Blind Rivet Installation).

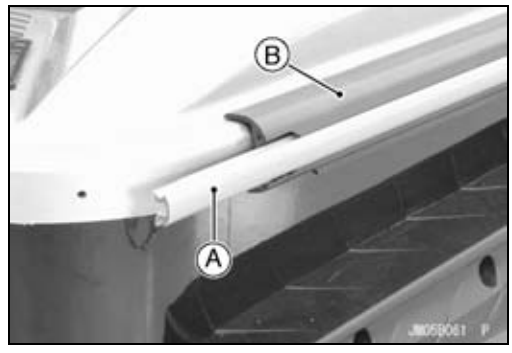
## Rubber Parts

### *Side Bumper Removal*

- Remove the plugs [A].
- Drill out the rivets [B] and washers [C] (see Blind Rivet Removal).
- Remove the corner bumper [D].




- Remove the trim strip [A] from the side bumper [B].
- Drill out the rivets (see Blind Rivet Removal).
- Remove the side bumper.

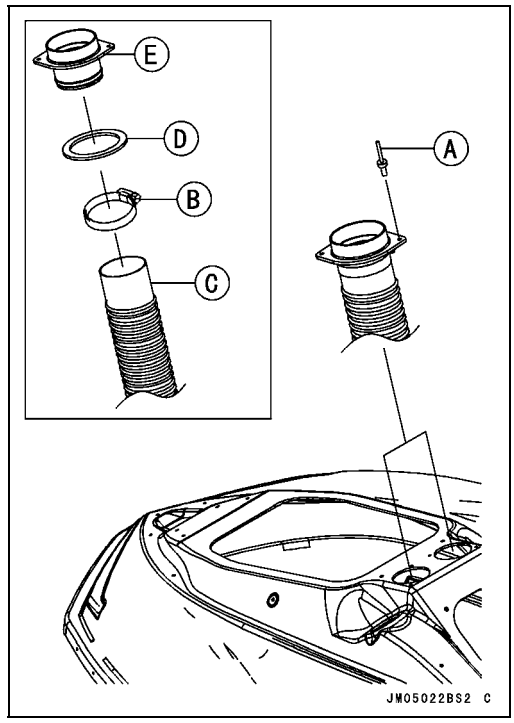



### *Side Bumper Installation*

- Secure the side bumpers to the hull flange with the rivets (see Blind Rivet Installation).
- Install the trim strip.

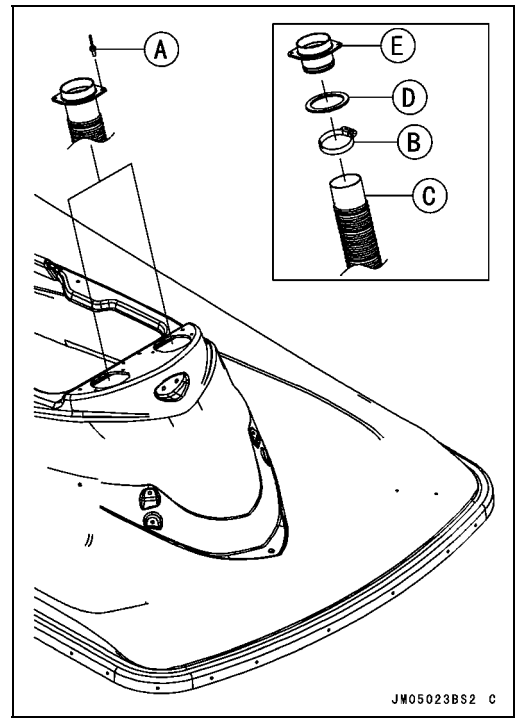
### *Air Duct Removal*

- To remove the front air ducts from the deck, remove the steering cover (see Steering Removal in the Steering chapter).
- Drill out the rivets [A] (see Blind Rivet Removal).
- Remove:
  Clamp [B]
  Front Air Duct [C]
  Damper [D]
  Duct [E]



## Rubber Parts

- To remove the rear air ducts from the deck, remove the handrail plate (see Handrail Plate Removal).
- Drill out the rivets [A] (see Blind Rivet Removal).
- Remove:
  Clamp [B]
  Rear Air Duct [C]
  Damper [D]
  Duct [E]




### *Air Duct Installation*

- Secure the air duct to the deck with the rivets (see Blind Rivet Installation).

# Electrical System

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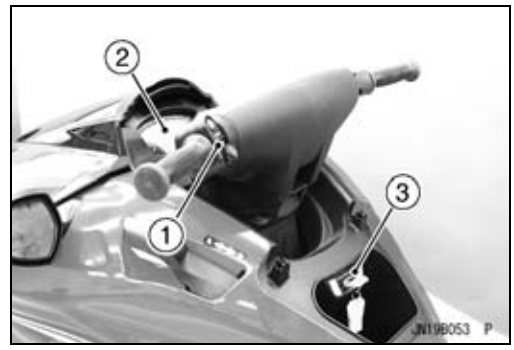
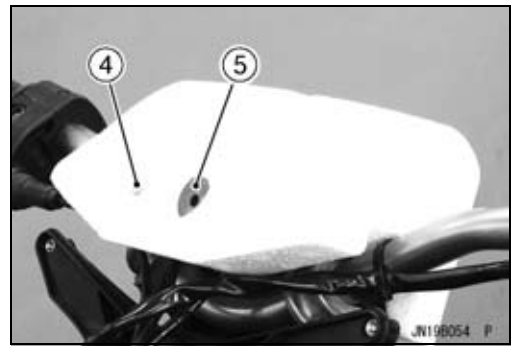
## Parts Location

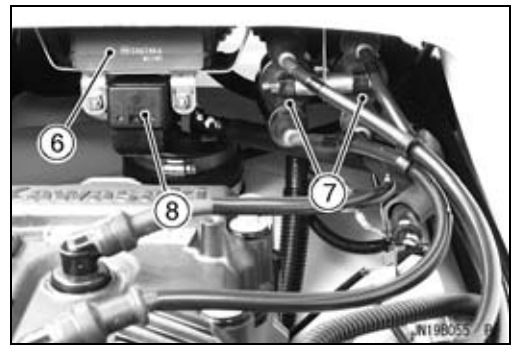
1. Start/Stop Switch Case
2. Meter Unit
3. Ignition Switch/Immobilizer Amplifier



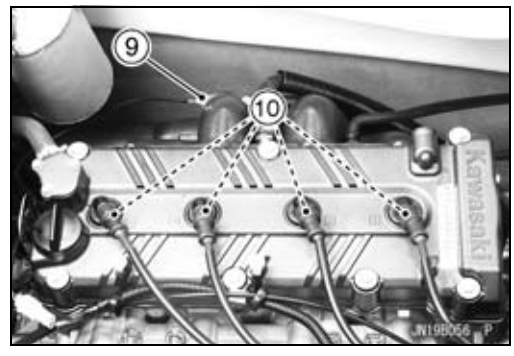

4. Air Temperature Sensor (for Meter Unit)
5. Buzzer



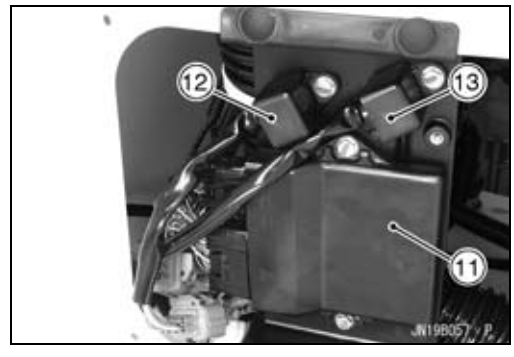

6. Regulator/Rectifier
7. Ignition Coils
8. Vehicle-down Sensor




9. Water Temperature Sensor
10. Spark Plugs




11. ECU
12. ECU Main Relay
13. Fuel Pump/System Relay




**NOTE**

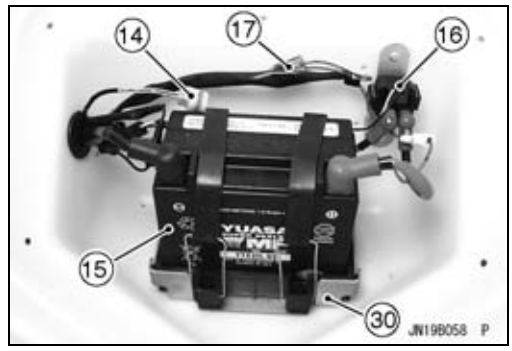
○*In this photo, the front access cover has been removed.*

## Parts Location

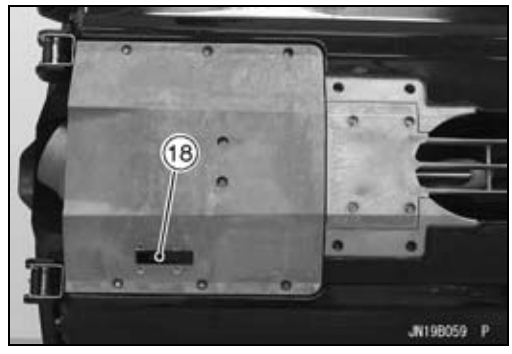
14. Immobilizer/Kawasaki Diagnostic System Connector
15. Battery 12 V/18 Ah
16. Starter Relay
17. Fuse Case for Main Fuse
30. Aluminum Tray (EUR Model only)

**NOTE**

○*In this photo, the battery cover has been removed.*

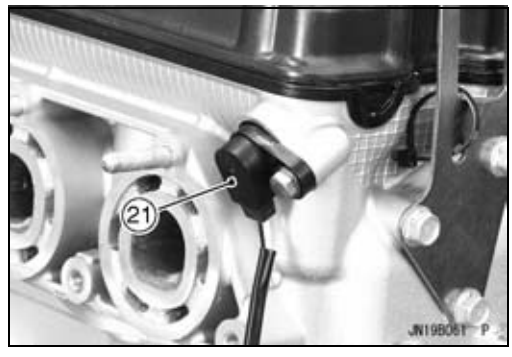



18. Speed Sensor

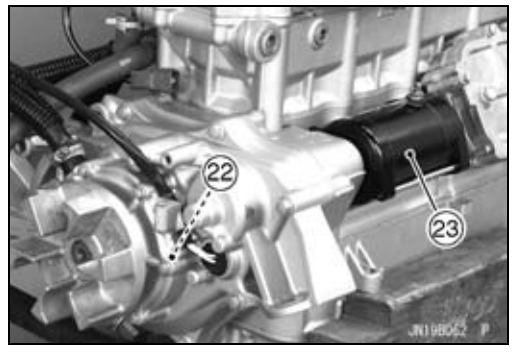



19. Intake Air Pressure Sensor
20. Intake Air Temperature Sensor

21. Camshaft Position Sensor

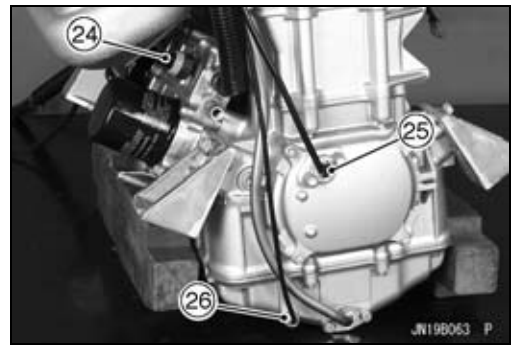



22. Alternator
23. Starter Motor

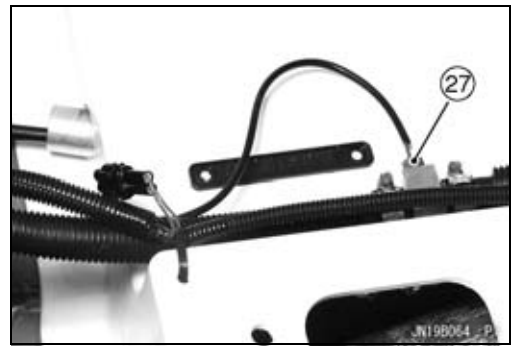


## Parts Location

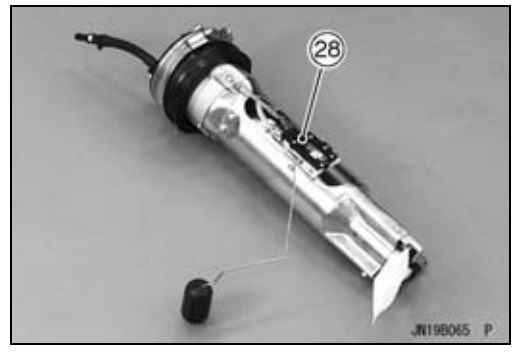
24. Oil Pressure Switch
25. Crankshaft Sensor
26. Oil Temperature Sensor



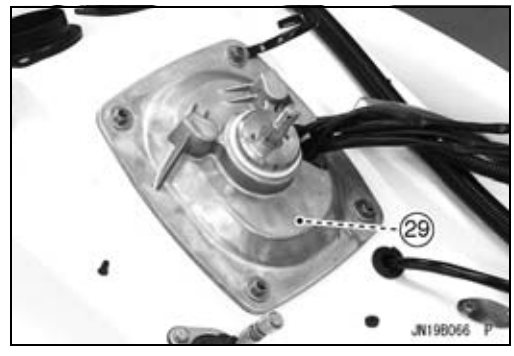

27. Water Temperature Sensor (for Meter Unit)



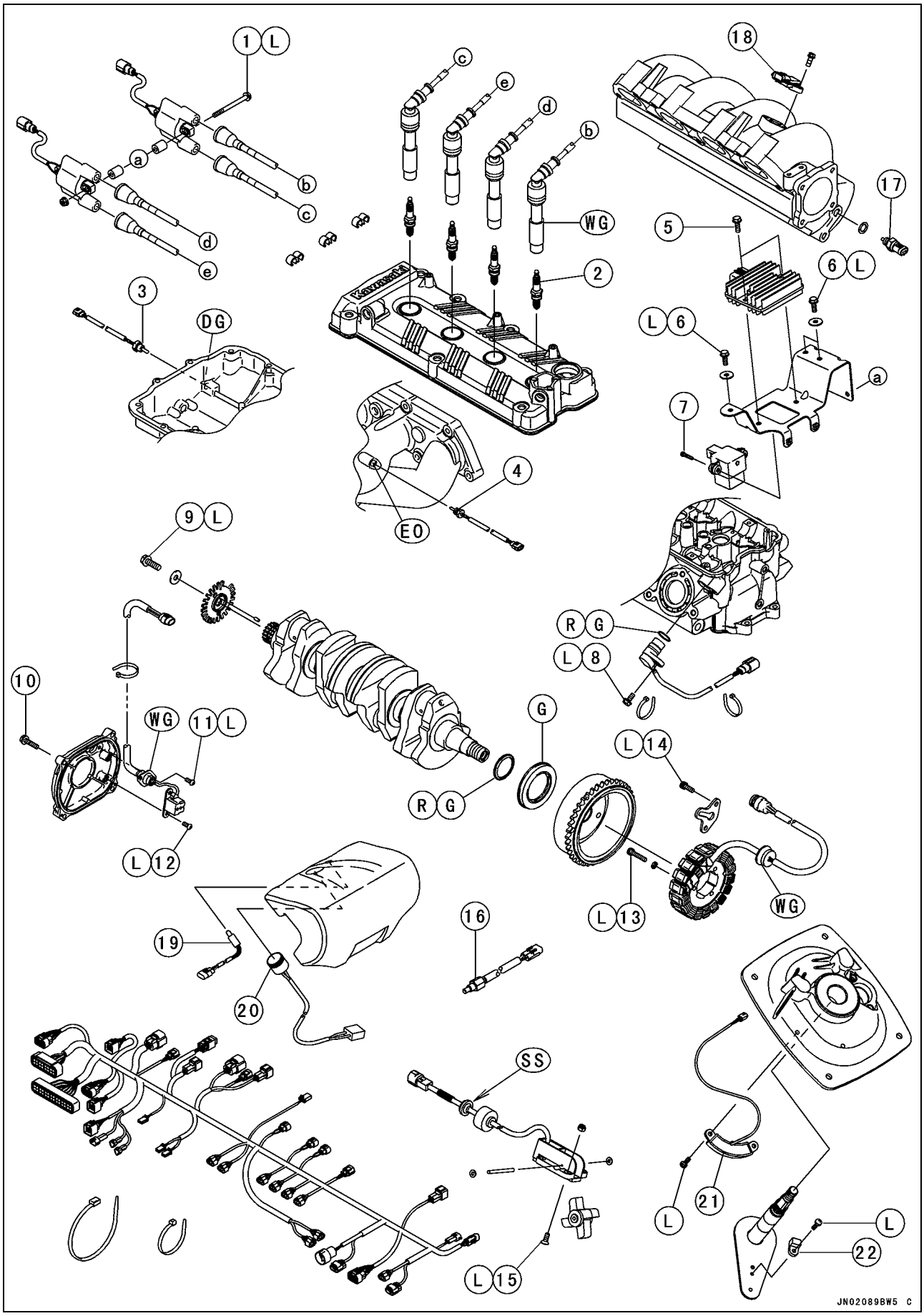

28. Fuel Level Sensor




29. Steering Position Sensor



## Exploded View



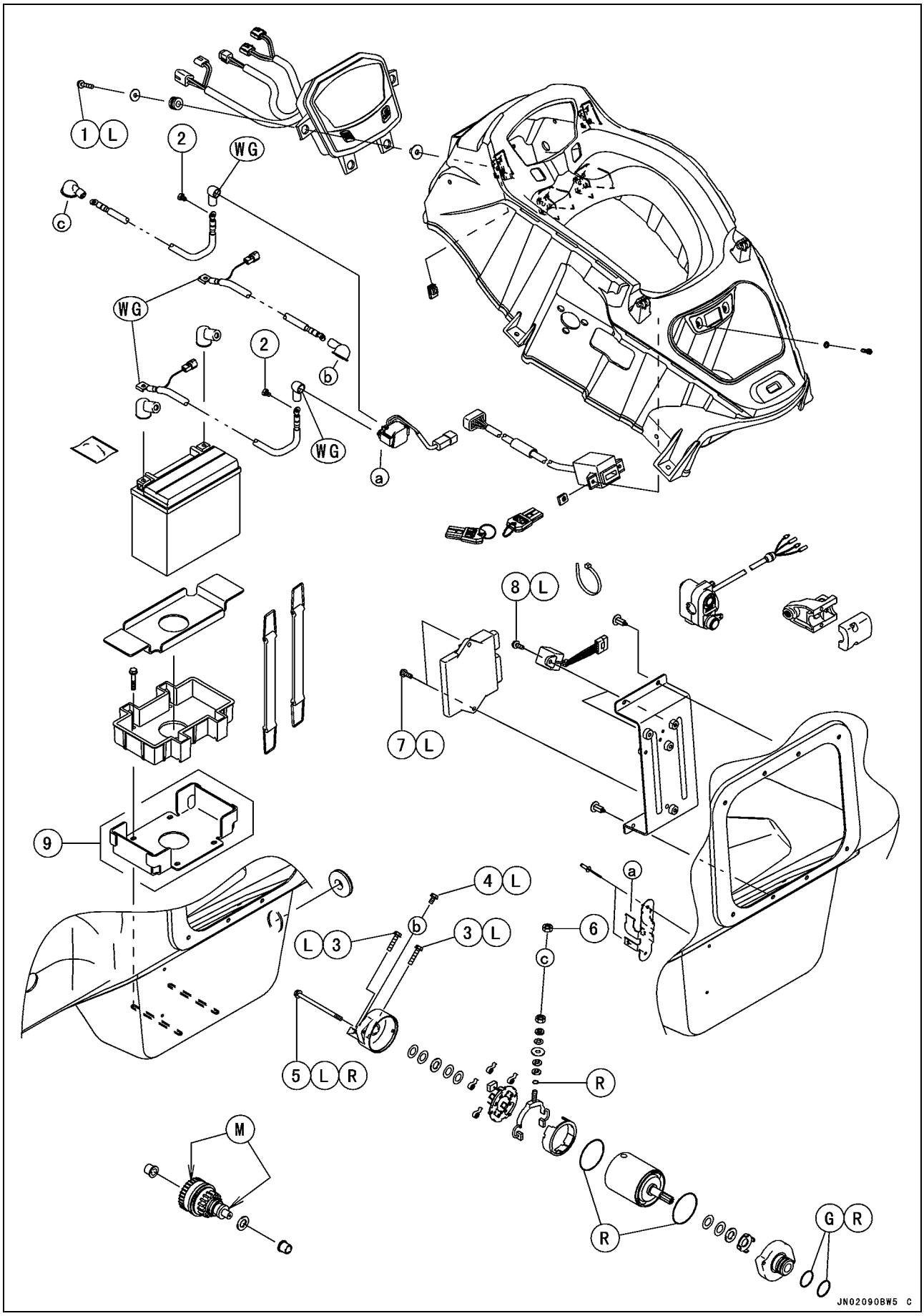
## Exploded View

| No. | Fastener | Torque | | | Remarks |
|---|---|---|---|---|---|
| | | N·m | kgf·m | ft·lb | |
| 1 | Ignition Coil Mounting Bolts | 8.8 | 0.90 | 78 in·lb | L |
| 2 | Spark Plugs | 13 | 1.3 | 115 in·lb | |
| 3 | Oil Temperature Sensor | 15 | 1.5 | 11 | |
| 4 | Water Temperature Sensor | 14.7 | 1.5 | 11 | |
| 5 | Regulator/Rectifier Bolts | 7.8 | 0.80 | 69 in·lb | |
| 6 | Bracket Bolts | 8.8 | 0.90 | 78 in·lb | L |
| 7 | Vehicle-down Sensor Mounting Screws | 1.5 | 0.15 | 13 in·lb | |
| 8 | Camshaft Position Sensor Bolt | 10 | 1.0 | 89 in·lb | L |
| 9 | Timing Rotor Bolt | 20 | 2.0 | 15 | L |
| 10 | Crankshaft Sensor Cover Bolts | 7.8 | 0.80 | 69 in·lb | |
| 11 | Rubber Grommet Holder Screws | 4.5 | 0.46 | 40 in·lb | L |
| 12 | Crankshaft Sensor Screws | 4.5 | 0.46 | 40 in·lb | L |
| 13 | Stator Coil Bolts | 12 | 1.2 | 106 in·lb | L |
| 14 | Stator Coil Grommet Holder Plate Bolts | 8.8 | 0.90 | 78 in·lb | L |
| 15 | Speed Sensor Mounting Screws | 3.9 | 0.40 | 35 in·lb | L |
| 16 | Water Temperature Sensor (for Meter Unit) | 8.8 | 0.90 | 78 in·lb | |

17. Intake Air Temperature Sensor
18. Intake Air Pressure Sensor
19. Air Temperature Sensor (for Meter Unit)
20. Buzzer
21. Steering Position Sensor
22. Magnet

DG: Fill the hollow with the heat transfer grease (Heat Transfer Grease, SCH-20: 92137-1002 or equivalent).
EO: Apply engine oil.
G: Apply grease.
L: Apply a non-permanent locking agent.
R: Replacement Parts
SS: Apply silicone sealant.
WG: Apply water-resistantce grease.

## Exploded View

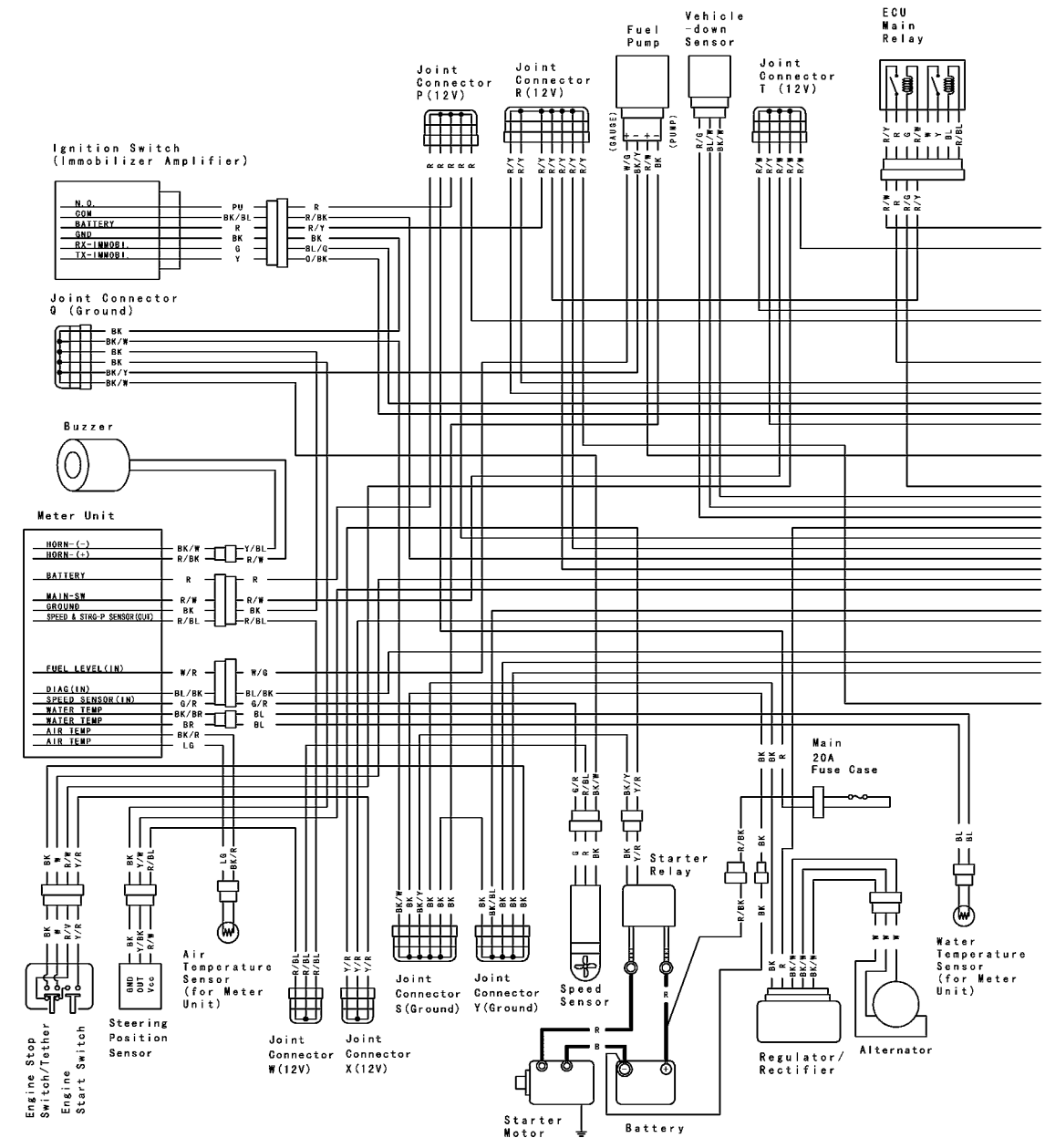


## Exploded View

| No. | Fastener | Torque | | | Remarks |
|---|---|---|---|---|---|
| | | N·m | kgf·m | ft·lb | |
| 1 | Meter Unit Mounting Bolts | 9.8 | 1.0 | 87 in·lb | L |
| 2 | Starter Relay Terminal Bolts | 5.5 | 0.56 | 49 in·lb | |
| 3 | Starter Motor Mounting Bolts | 8.8 | 0.90 | 78 in·lb | L |
| 4 | Starter Motor Ground Bolt | 8.8 | 0.90 | 78 in·lb | L |
| 5 | Starter Motor Through Bolts | 6.4 | 0.65 | 57 in·lb | L, R |
| 6 | Starter Motor Terminal Nut | 8.8 | 0.90 | 78 in·lb | |
| 7 | ECU Mounting Bolts | 3.0 | 0.31 | 27 in·lb | L |
| 8 | Relay Mounting Bolts | 2.5 | 0.25 | 22 in·lb | L |

9. Aluminum Tray (EUR Model)
G: Apply grease.
L: Apply a non-permanent locking agent.
M: Apply molybdenum disulfide grease.
R: Replacement Parts
WG: Apply water-resistance grease.

## Wiring Diagram



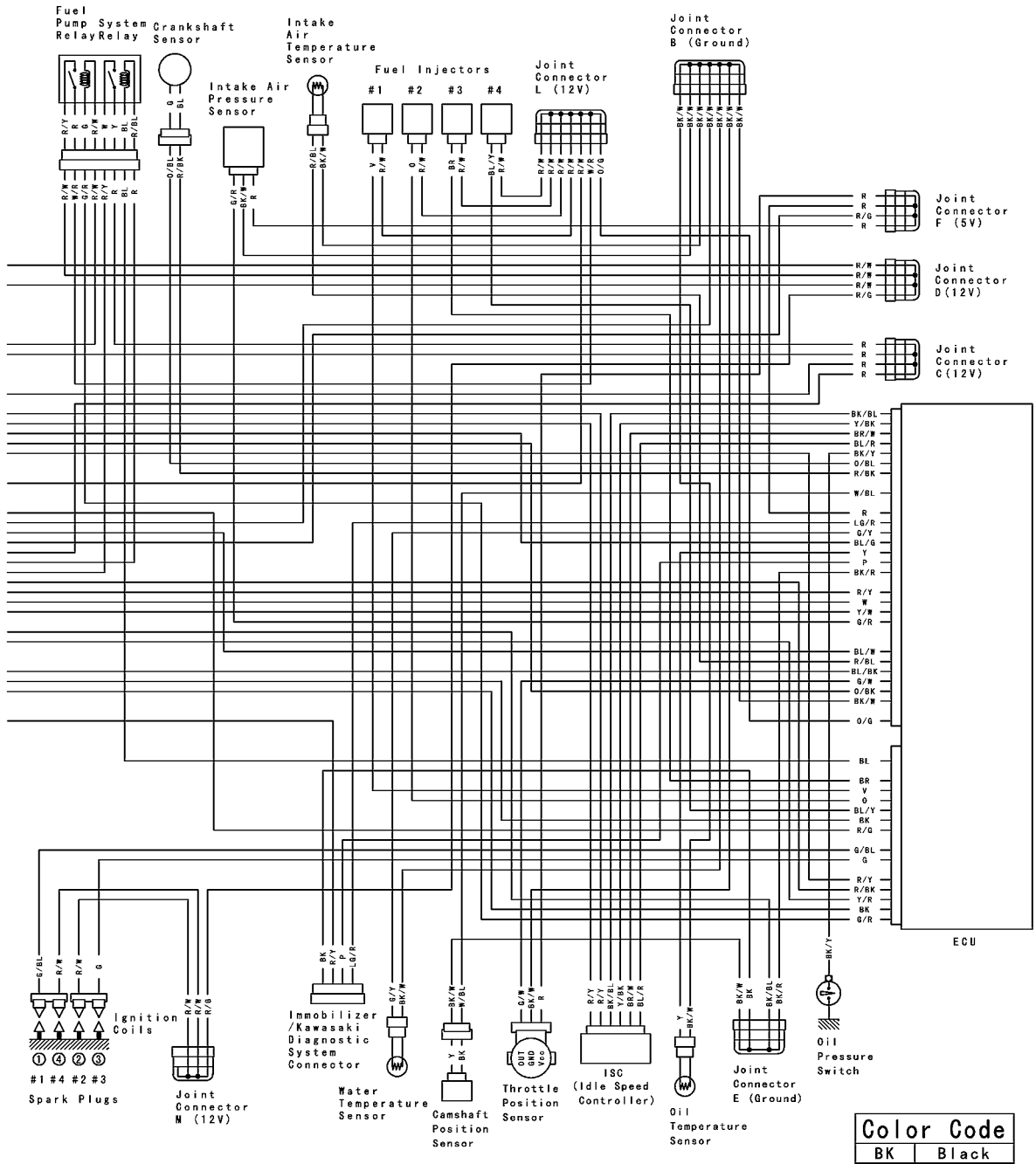

| Ignition Switch | | |
|---|---|---|
| Color | PU | BK/BL |
| | | |
| | | |
| Push | | |

| Stop Switch | | | | | | |
|---|---|---|---|---|---|---|
| | TETHER CODE | BK | W | R/PU | Y/R |
| | SET | | | | |
| PUSH | PULL | | | | |

| Start Switch | | |
|---|---|---|
| | Y/R | Y/R |
| | | |
| PUSH | | |

W2L0639CW5 C

## Wiring Diagram




| Color Code | |
|---|---|
| BK | Black |
| BL | Blue |
| BR | Brown |
| CH | Chocolate |
| G | Green |
| GY | Gray |
| LB | Light Blue |
| LG | Light Green |
| O | Orange |
| P | Pink |
| PU | Purple |
| R | Red |
| V | Violet |
| W | White |
| Y | Yellow |

(98052-0639C)

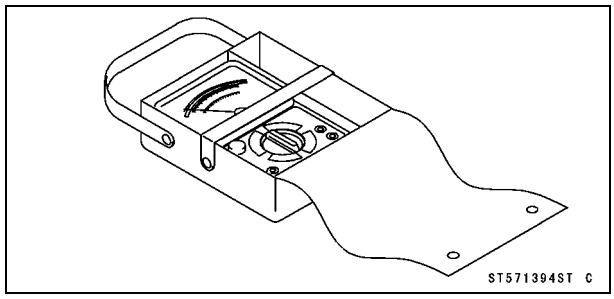
W2R0639CW5 C

## Specifications

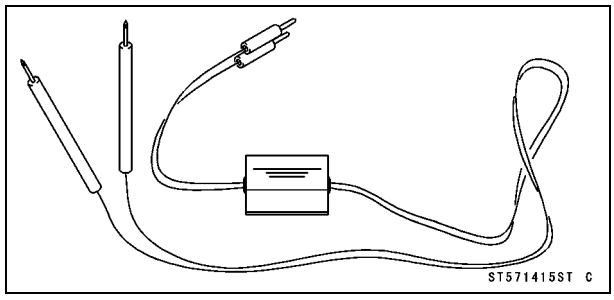
| Item | Standard |
|---|---|
| **Battery** | |
| Type | Sealed Battery |
| Model Name | YTX20L-BS |
| Capacity | 12 V 18 Ah |
| Voltage | 12.8 V or more |
| **Electric Starter System** | |
| Starter Motor: | |
| Brush Length | 12 mm (0.47 in.) (Service Limit: 6.5 mm, 0.26 in.) |
| Commutator Diameter | 28 mm (1.10 in.) (Service Limit: 27 mm, 1.06 in.) |
| **Charging System** | |
| Type | Three-phase AC |
| Regulator/Rectifier Output Voltage | 14.2 ~ 15.2 V |
| Alternator Output Voltage | 48 ~ 72 V at 3 000 r/min (rpm) |
| Stator Coil Resistance | 0.432 ~ 0.648 Ω at 20°C (68°F) |
| **Ignition System** | |
| Ignition Coil: | |
| Primary Winding Resistance | 1.44 ~ 2.16 Ω |
| Secondary Winding Resistance | 11.76 ~ 17.64 kΩ |
| Primary Peak Voltage | 250 V or more |
| Spark Plug: | |
| Type | NGK CR9EK |
| Gap | 0.7 ~ 0.8 mm (0.028 ~ 0.032 in.) |
| Crankshaft Sensor Resistance | 408 ~ 612 Ω at 20°C (68°F) |
| Crankshaft Sensor Peak Voltage | 2.5 V or more |
| Camshaft Position Sensor Resistance | 400 ~ 460 Ω at 20°C (68°F) |
| Camshaft Position Sensor Peak Voltage | 0.4 V or more |
| **Kawasaki Smart Steering (KSS) System** | |
| Steering Position Sensor Clearance | 0.5 ~ 1.5 mm (0.02 ~ 0.06 in.) |
| **Sensors** | |
| Fuel Level Sensor Resistance: | |
| Full Position | 2 ~ 4 Ω |
| Empty Position | 117 ~ 123 Ω |
| Water Temperature Sensor Resistance | see text. |
| Oil Temperature Sensor Resistance | see text. |
| Air Temperature Sensor Resistance | see text. |

## Special Tools and Sealant

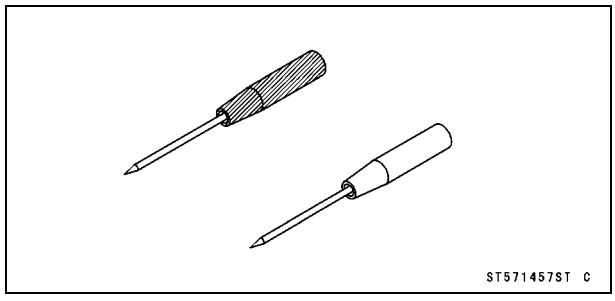
**Hand Tester:**
**57001-1394**



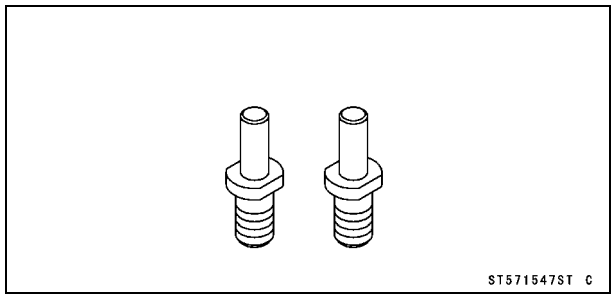

**Peak Voltage Adapter:**
**57001-1415**



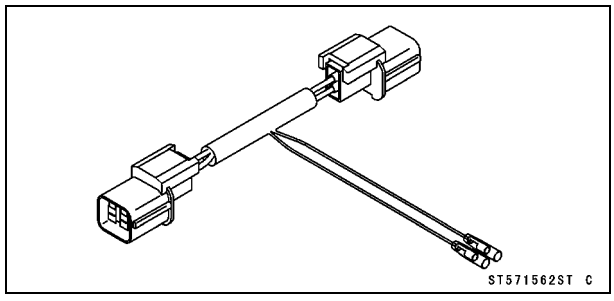

**Needle Adapter Set:**
**57001-1457**



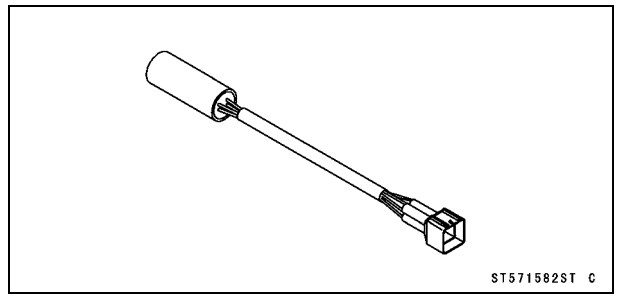

**Holder Attachment:**
**57001-1547**



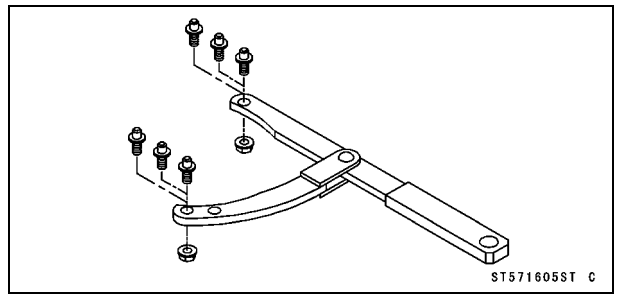

**Harness Adapter:**
**57001-1562**



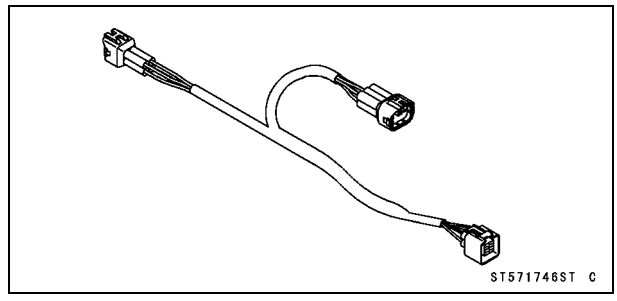

**Key Registration Unit:**
**57001-1582**



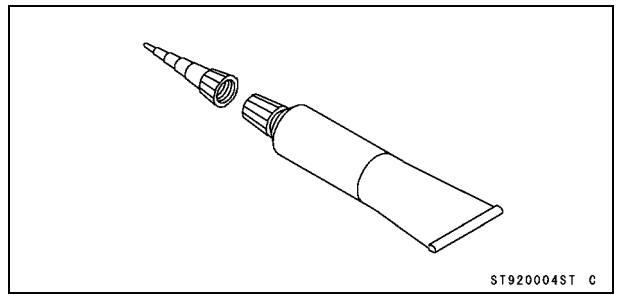

**Flywheel & Pulley Holder:**
**57001-1605**




**Key Registration Adapter:**
**57001-1746**




**Liquid Gasket, TB1211F:**
**92104-0004**



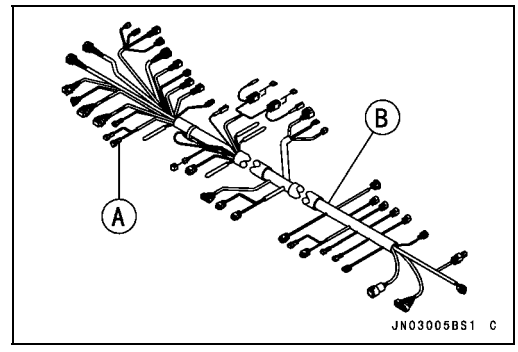
## Precautions

There are a number of important precautions that are musts when servicing electrical systems. Learn and observe all the rules below.

- Do not reverse the battery cable connections. This will burn out the diodes on the electrical parts.
- Always check battery condition before condemning other parts of an electrical system. A fully charged battery is a must for conducting accurate electrical system tests.
- The electrical parts should never be struck sharply, as with a hammer, or allowed to fall on a hard surface. Such a shock to the parts can damage them.
- To prevent damage to electrical parts, do not disconnect the battery cables or any other electrical connections when the ignition switch is on (ignition key is inserted), or while the engine is running.
- Because of the large amount of current, never keep the starter button pushed when the starter motor will not turn over, or the current may burn out the starter motor windings.
- Take care not to short the cables that are directly connected to the battery positive (+) terminal to the chassis ground.
- Troubles may involve one or in some cases all items. Never replace a defective part without determining what CAUSED the failure. If the failure was caused by some other item or items, they must be repaired or replaced, or the new replacement will soon fail again
- Make sure all connectors in the circuit are clean and tight, and examine leads for signs of burning, fraying, etc. Poor leads and bad connections will affect electrical system operation.
- Measure coil and winding resistance when the part is cold (at room temperature).

## Electrical Wiring

### *Wiring Inspection*




- Visually inspect the wiring for signs of burning, fraying, etc.

★If any wiring is poor, replace the damaged wiring.

- Pull each connector [A] apart and inspect it for corrosion, dirt, and damage.

★If the connector is corroded or dirty, clean it carefully. If it is damaged, replace it.

- Check the wiring for continuity.

○Use the wiring diagram to find the ends of the lead which is suspected of being a problem.

○Connect the hand tester between the ends of the leads.

**Special Tool - Hand Tester: 57001-1394**

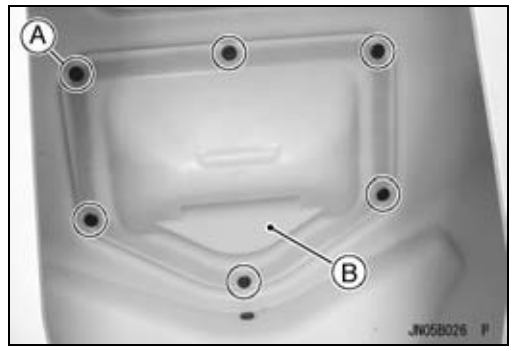
○Set the tester to the × 1 Ω range, and read the tester.

★If the tester does not read 0 Ω, the lead is defective. Replace the lead or the wiring harness [B] if necessary.

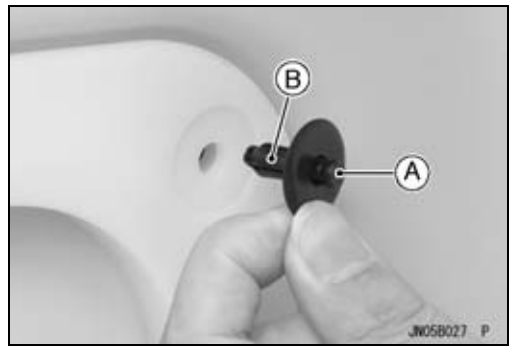
## Battery

### *Battery Cover Removal/Installation*

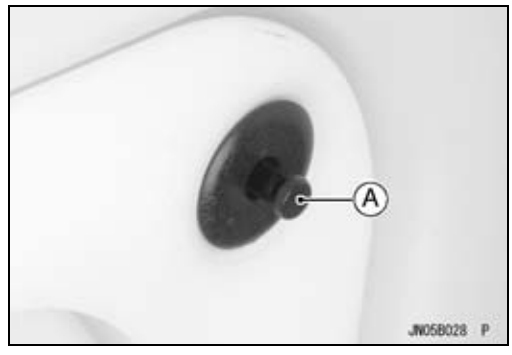
- Open the front storage compartment cover (see Front Storage Compartment Cover Removal in the Hull/Engine Hood chapter).
- Remove the front storage case.
- Push in the pin heads [A] and remove the battery cover [B].




- To install the battery cover, pull up the pin head [A] as shown and install the rivet [B].




- Push in the pin head [A].



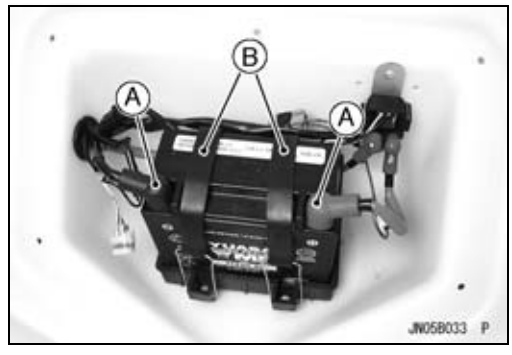

### *Battery Removal*

- Disconnect the battery cables [A].

**⚠ WARNING**

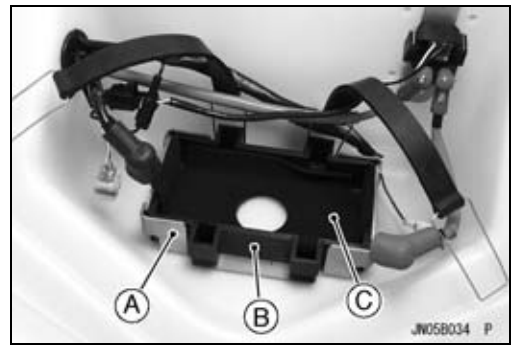
**Electrical components, including the battery, can cause shocks and burns. To prevent injury and damage to electrical components, always disconnect the grounded cable first.**

- Unhook the battery straps [B].
- Carefully lift the battery from the battery compartment.



## Battery

### *Battery Installation*




- For EUR model, be sure the aluminum tray [A] is in position under the battery compartment [B].
- Be sure the battery damper [C] is in position in the battery compartment.
- Hook the battery straps.
- Connect the battery cables, positive first.

○After attaching both cables, coat the terminals and cable ends with water-resistance grease to prevent corrosion.

○Slide the rubber caps over each terminal.

**⚠ WARNING**

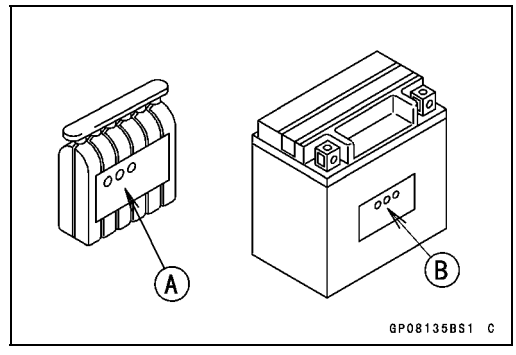
**The shock contains high-pressure nitrogen gas that when suddenly released can eject oil and internal shock parts at high velocity, causing serious injury. To avoid injury, do not point a suitable tool toward your face or body when releasing nitrogen gas pressure since an oil mist is often released with the nitrogen. Always release nitrogen gas pressure before disassembling the rear shock absorber to prevent explosive separation of parts.**

***NOTICE***

**Reversing the battery connections may damage the electrical system. To prevent damage, be sure the battery connections are correct.**

### *Battery Activation*

**Electrolyte Filling**




- Make sure that the model name [A] of the electrolyte container matches the model name [B] of the battery. These names must be the same.

**Battery Model Name**

**JT1500K: YTX20L-BS**

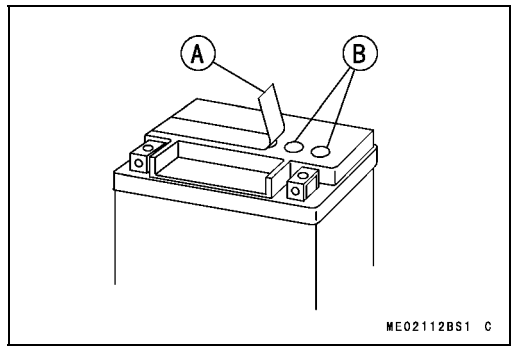
***NOTICE***

**Each battery comes with its own specific electrolyte container; using the wrong container may overfill the battery with incorrect electrolyte, which can shorten battery life and deteriorate battery performance. Be sure to use the electrolyte container with the same model name as the battery since the electrolyte volume and specific gravity vary with the battery type.**

## Battery

**NOTICE**

**Do not remove the aluminum sealing sheet [A] from the filler ports [B] until just prior to use. Be sure to use the dedicated electrolyte container for correct electrolyte volume.**




**⚠ DANGER**

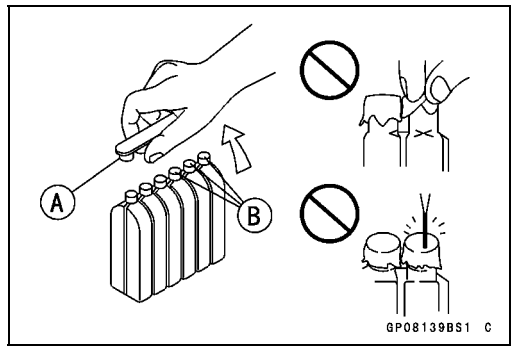
**Sulfuric acid in battery electrolyte can cause severe burns. To prevent burns, wear protective clothing and safety glasses when handling electrolyte. If the electrolyte comes in contact with your skin or eyes, wash the area with liberal amounts of water and seek medical attention for more severe burns.**

- Place the battery on a level surface.
- Check to see that the sealing sheet has no peeling, tears, or holes in it.
- Remove the sealing sheet.

**NOTE**

○*The battery is vacuum sealed. If the sealing sheet has leaked air into the battery, it may require a longer initial charge.*

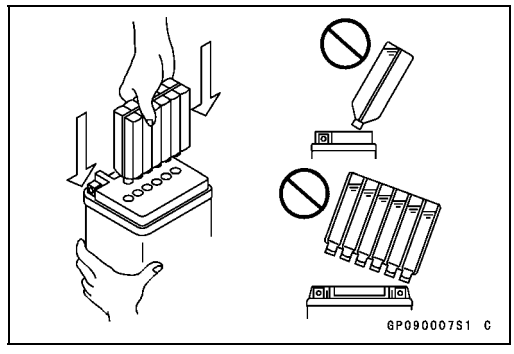
- Remove the electrolyte container from the vinyl bag.
- Detach the strip of caps [A] from the container and set aside, these will be used later to seal the battery.




**NOTE**

○*Do not pierce or otherwise open the sealed cells [B] of the electrolyte container. Do not attempt to separate individual cells.*

- Place the electrolyte container upside down with the six sealed cells into the filler ports of the battery. Hold the container level, push down to break the seals of all six cells. You will see air bubbles rising into each cell as the ports fill.



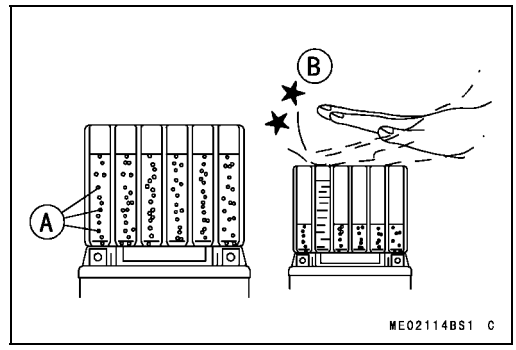

**NOTE**

○*Do not tilt the electrolyte container.*

## Battery

- Check the electrolyte flow.

★If no air bubbles [A] are coming up from the filler ports, or if the container cells have not emptied completely, tap the container [B] a few times.




**NOTE**

○*Be careful not to have the battery fall down.*

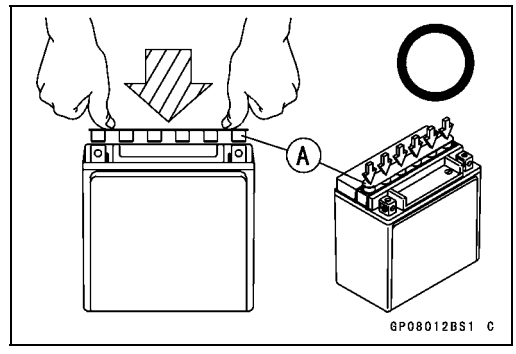
- Keep the container in place. Don't remove the container from the battery, the battery requires all the electrolyte from the container for proper operation.

***NOTICE***

**Removal of the container before it is completely empty can shorten the service life of the battery. Do not remove the container until it is completely empty.**

- After filling, let the battery sit for 20 ~ 60 minutes with the electrolyte container kept in place, which is required for the electrolyte to fully permeate into the plates.
- Make sure that the container cells have emptied completely, and remove the container from the battery.

- Place the strip of caps [A] loosely over the filler ports, press down firmly with both hands to seat the strip of caps into the battery (don't pound or hammer). When properly installed, the strip of caps will be level with the top of the battery.

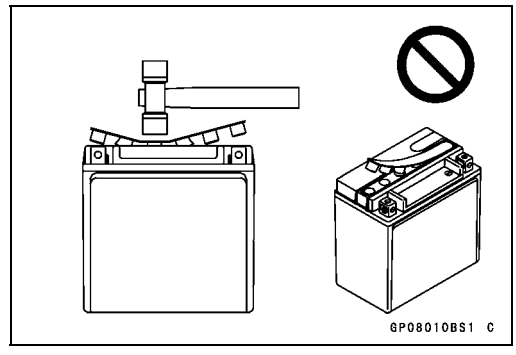



***NOTICE***

**Once the strip of caps is installed onto the battery, never remove the caps, nor add water or electrolyte to the battery.**

**NOTE**

○*Charging the battery immediately after filling can shorten service life.*



## Battery

**Initial Charge**

● Newly activated sealed batteries require an initial charge.

**Standard Charge: 1.8 A × 5 ~ 10 hours**

★If using a recommended battery charger, follow the charger's instructions for newly activated sealed battery.

**Kawasaki-recommended chargers:**
**Battery Mate 150-9**
**OptiMate PRO 4-S/PRO S/PRO2**
**Yuasa MB-2040/2060**
**Christie C10122S**

★If the above chargers are not available, use equivalent one.

● Let battery sit 30 minutes after initial charge, then check voltage using a voltmeter. (Voltage immediately after charging becomes temporarily high. For accurate measuring, let the battery sit for given time.)

**NOTE**

○*Charging rates will vary depending on how long the battery has been stored, temperature, and the type of charger used. If voltage is not at least 12.8 V, repeat charging cycle.*

○*To ensure maximum battery life and customer satisfaction, it is recommended the battery be load tested at three times its amp-hour rating for 15 seconds.*
*Re-check voltage and if less than 12.8 V repeat the charging cycle and load test. If still below 12.8 V the battery is defective.*

### *Precautions*

1) No need of topping-up
No topping-up is necessary in this battery until it ends its life under normal use. Forcibly prying off the seal cap to add water is very dangerous. Never do that.

2) Refreshing charge
If an engine will not start, it indicates the battery has been discharged. Give refresh charge for 5 to 10 hours with charge current shown in the text (see Refreshing Charge).
When a fast charge is inevitably required, do it following precisely the maximum charge current and time conditions indicated on the battery.

***NOTICE***

**This battery is designed to sustain no unusual deterioration if refresh-charged according to the method specified above. However, the battery's performance may be reduced noticeably if charged under conditions other than given above. Never remove the seal cap during refresh charge.**
**If by chance an excessive amount of gas is generated due to overcharging, the relief valve releases the gas to keep the battery normal.**

3) When you do not use the watercraft for months:
Give a refresh charge before you store the watercraft and store it with the negative lead removed. Give a refresh charge **once a month** during storage.

4) Battery life:
If the battery will not start the engine even after several refresh charges, the battery has exceeded its useful life. Replace it (Provided, however, the watercraft's starting system has no problem).

## Battery

**⚠ DANGER**

**Batteries produce an explosive gas mixture of hydrogen and oxygen that can cause serious injury and burns if ignited. Keep the battery away from sparks and open flames during charging. When using a battery charger, connect the battery to the charger before turning on the charger. This procedure prevents sparks at the battery terminals which could ignite any battery gases. The electrolyte contains sulfuric acid. Be careful not to have it touch your skin or eyes. If touched, wash it off with liberal amount of water and seek medial attention for more severe burns.**

### *Interchange*

A sealed battery can fully display its performance only when combined with a proper watercraft electric system. Therefore, replace a sealed battery only on watercraft which was originally equipped with a sealed battery.

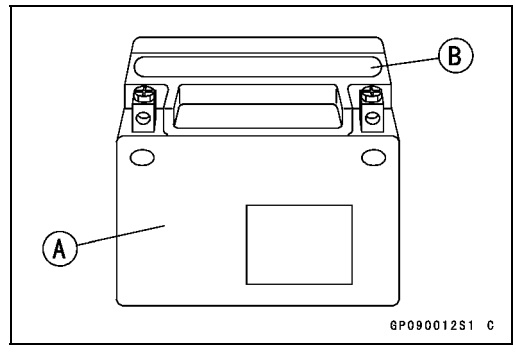
Be careful, if a sealed battery is installed on watercraft which had an ordinary battery as original equipment, the sealed battery's life will be shortened.

### *Charging Condition Inspection*

- Refer to Battery Charging Condition Inspection in the Periodic Maintenance chapter.

### *Refreshing Charge*

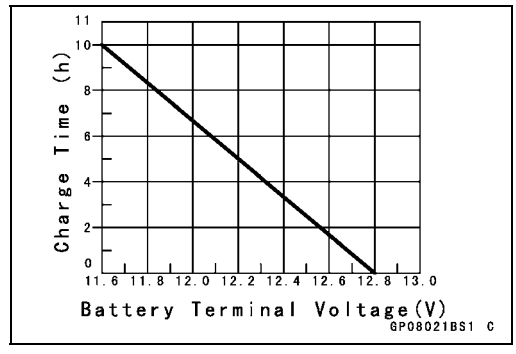
- Remove the battery [A] (see Battery Removal).
- Refresh-charge by following method according to the battery terminal voltage.




***NOTICE***

**The battery is a sealed type and never needs to have water added. Never remove the strip cap [B], even during charging, or you may damage the battery. Never add water. Charge the battery with the current and time as stated below.**

**Terminal Voltage: 11.5 ~ less than 12.8 V**
**Standard Charge: 1.8 A × 5 ~ 10 h (see following chart)**
**Quick Charge: 9.0 A × 1.0 h**




***NOTICE***

**If possible, do not quick charge. If the quick charge is done due to unavoidable circumstances, do standard charge later on.**

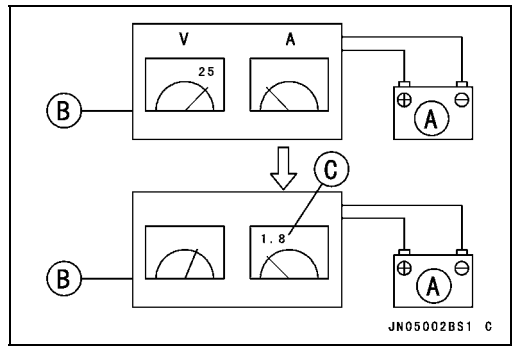
**Terminal Voltage: less than 11.5 V**
**Charging Method: 1.8 A × 20 h**

## Battery

**NOTE**

○*Increase the charging voltage to a maximum voltage of 25 V if the battery will not accept current initially. Charge for no more than five minutes at the increased voltage then check if the battery is drawing current.*

○*If the battery will accept current, decrease the voltage and charge by the standard charging method described on the battery case. If the battery will not accept current after 5 minutes, replace the battery.*




Battery [A]
Battery Charger [B]
Standard Value [C]

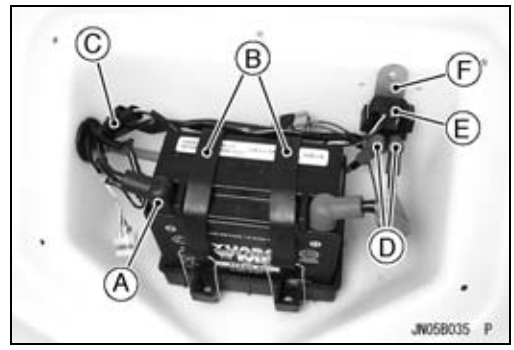
● Determine battery condition after refreshing charge.

○Determine the condition of the battery 30 minutes after completion of the charge by measuring the terminal voltage according to the table below.

| Criteria | Judgement |
|---|---|
| 12.8 V or more | Good |
| 12.0 ~ less than 12.8 V | Charge insufficient → Recharge |
| less than 12.0 V | Unserviceable → Replace |

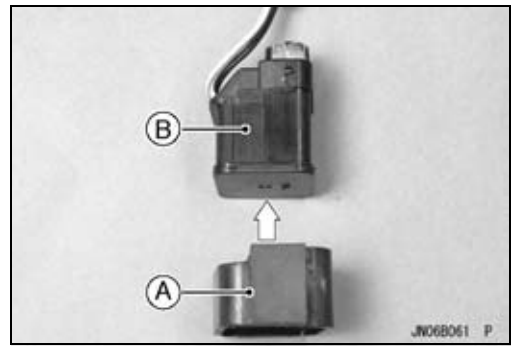
## Electric Starter System

### *Starter Relay Removal*

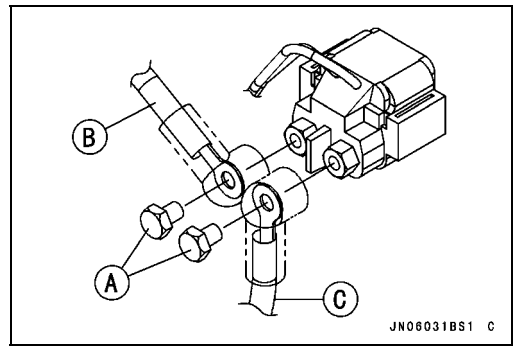



- Remove:
  Battery Cover (see Battery Cover Removal/Installation)
- Disconnect the negative battery cable [A].
- Unhook the battery straps [B].
- Disconnect the starter relay lead connector [C].
- Slide out the rubber caps [D] and remove the starter relay terminal bolts.
- Take the starter relay [E] off the bracket [F].

### *Starter Relay Installation*



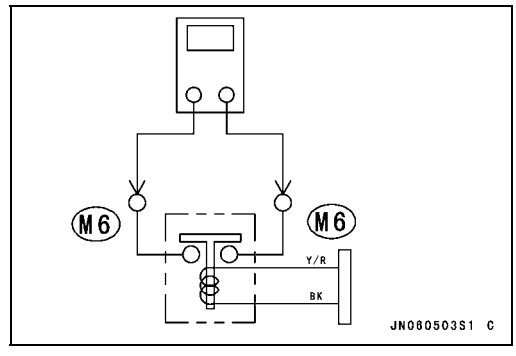

- Install the rubber damper [A] to the starter relay [B] as shown in the figure.




- Install the starter relay, and tighten the starter relay terminal bolts [A].
  Starter Motor Cable [B]
  Battery Positive Cable [C]

  **Torque - Starter Relay Terminal Bolts: 5.5 N·m (0.56 kgf·m, 49 in·lb)**
- Apply water-resistance grease to both terminals.
- Fill the terminal rubber caps full with water-resistance grease and install the rubber caps on the terminal bolts.
- Connect the starter relay lead connector.
- Hold the starter relay lead and the starter motor cable with the battery strap.

### *Starter Relay Inspection*




- Remove the starter relay (see Starter Relay Removal).
- Set the hand tester to × 1 Ω range.

  **Special Tool - Hand Tester: 57001-1394**
- Connect the tester leads as shown in the figure.

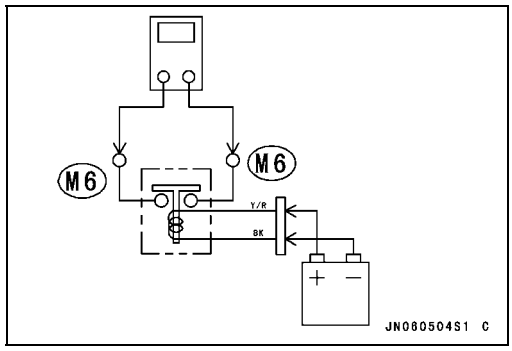
★If resistance is less than infinite, the starter relay switch is not returning and must be replaced.

## Electric Starter System

- Connect the tester leads as shown in the figure.
- Activate starter relay switch by connecting a 12 V battery as shown in the figure.

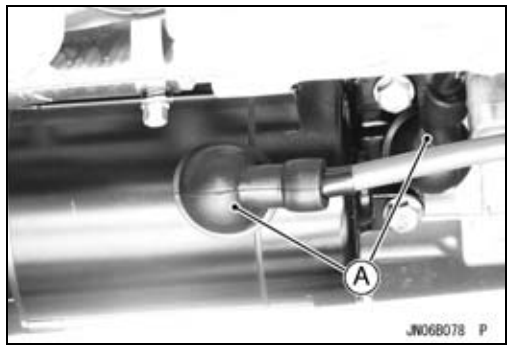
★If the starter relay switch clicks and the hand tester indicates zero resistance, the starter relay switch is good.

★If the tester indicates high or infinite (∞) resistance, the starter relay switch is defective and must be replaced.

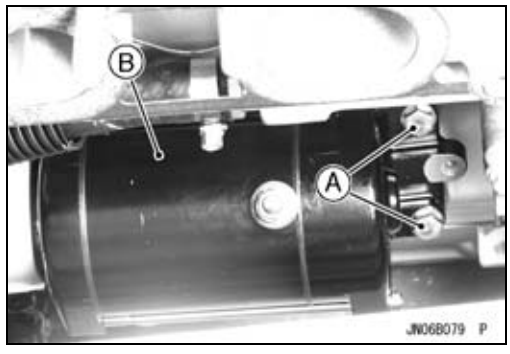



### *Starter Motor Removal*

- Remove:
  Seat (see Seat Removal in the Hull/Engine Hood chapter)
  Intake Manifold (see Intake Manifold Removal in the Fuel System (DFI) chapter)
- Slide out the rubber caps [A] and remove the starter motor ground bolt and starter motor terminal nut.




- Remove:
  Starter Motor Mounting Bolts [A]
  Starter Motor [B]

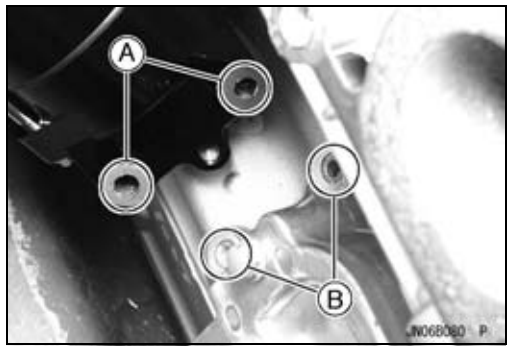



### *Starter Motor Installation*

***NOTICE***

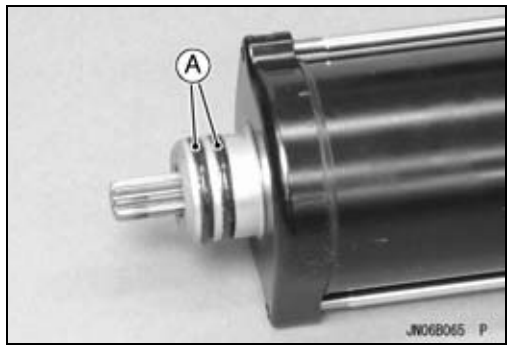
**Tapping the starter shaft or body could damage the motor. Do not tap the starter motor shaft or body.**

- When installing the starter motor, clean the starter motor legs [A] and crankcase [B] where the starter motor is grounded.




- Apply grease to the new O-rings [A].
- Install the starter motor.
- Apply a non-permanent locking agent to the starter motor mounting bolts.
- Tighten:

**Torque - Starter Motor Mounting Bolts: 8.8 N·m (0.90 kgf·m, 78 in·lb)**



## Electric Starter System

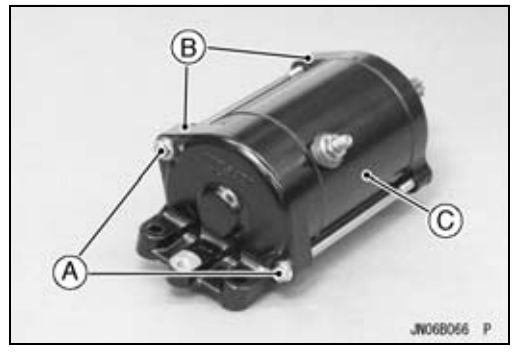
- Apply a non-permanent locking agent to the starter motor ground bolt.
- Tighten:

**Torque - Starter Motor Ground Bolt: 8.8 N·m (0.90 kgf·m, 78 in·lb)**
**Starter Motor Terminal Nut: 8.8 N·m (0.90 kgf·m, 78 in·lb)**

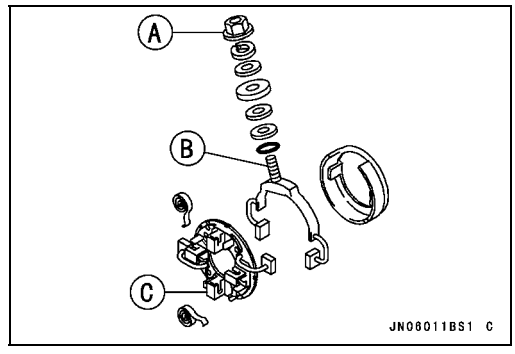
- Apply water-resistance grease to the ground bolt and the terminal nut.

### *Starter Motor Disassembly*

- Remove the starter motor (see Starter Motor Removal).
- Take off the starter motor through bolts [A] and remove both end covers [B] and pull the armature out of the yoke [C].

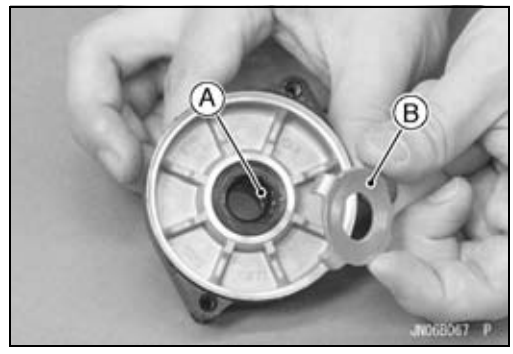



- Remove the terminal locknut [A] and terminal bolt [B], and then remove the brush with the brush plate [C] from the yoke.

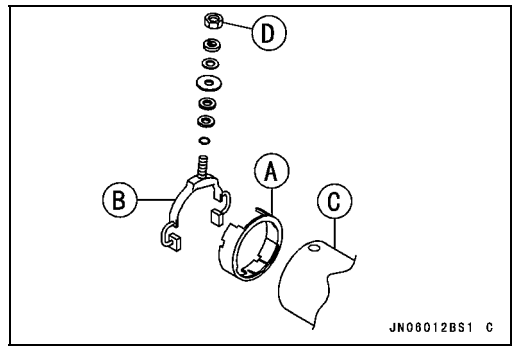



### *Starter Motor Assembly*

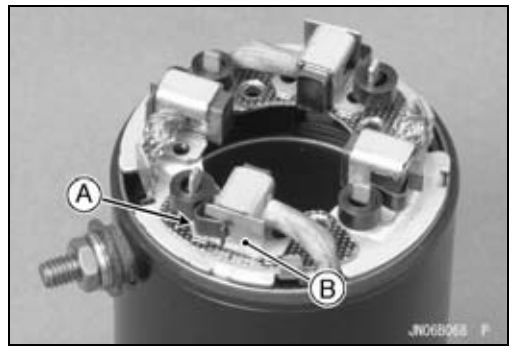
- Apply a thin coat of grease to the oil seal [A].
- Fit the toothed washer [B] into the end cover.



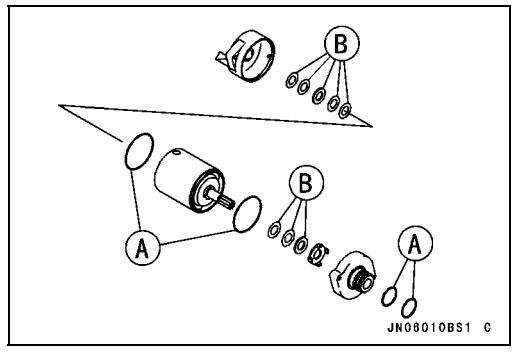

- Install the plate cover [A] and the positive brush assembly [B] in the yoke [C].
- Tighten the terminal nut [D] securely.



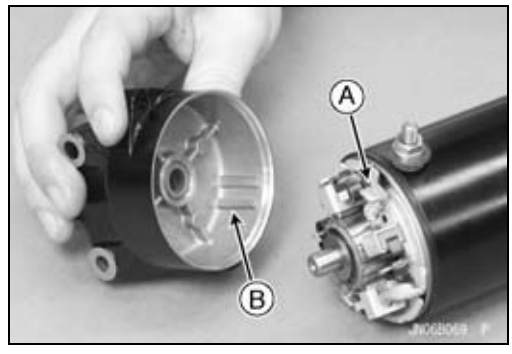
- Holding the spring ends [A] with suitable plates [B], put the armature among the brushes.




- Install the new O-rings [A] and the washers [B] as shown.




- Fit the tongue [A] on the brush plate into the end cover groove [B].




- Replace the starter motor through bolts with new ones.
- Apply a non-permanent locking agent to the starter motor through bolts.
- Tighten:

**Torque - Starter Motor Through Bolts: 6.4 N·m (0.65 kgf·m, 57 in·lb)**

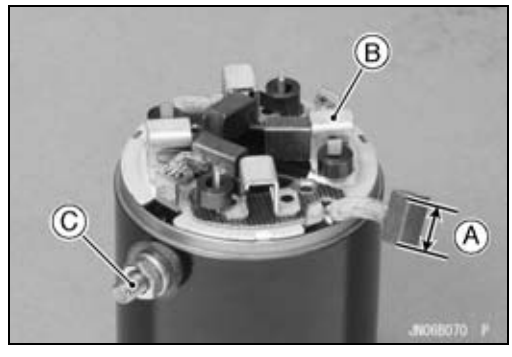
### *Brush Inspection*

- Measure the minimum length [A] of each brush.

★If any is worn down to the service limit, replace the negative brush assembly [B] and the positive brush assembly [C].

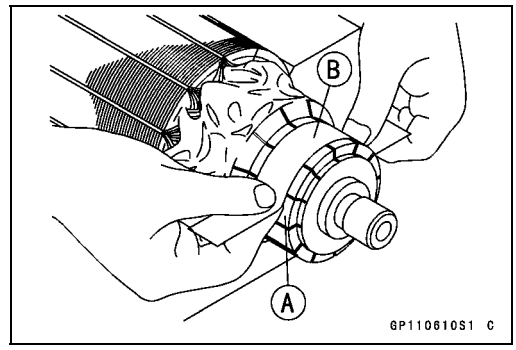
**Starter Motor Brush Length**

| | |
|---|---|
| **Standard:** | **12 mm (0.47 in.)** |
| **Service Limit:** | **6.5 mm (0.26 in.)** |

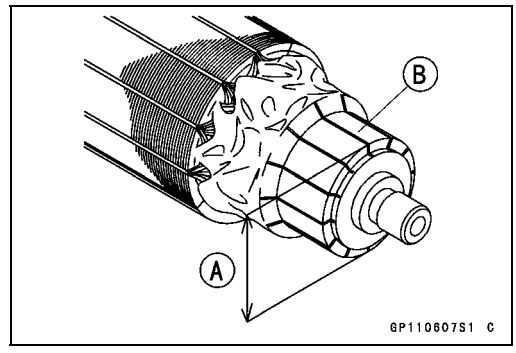


## Electric Starter System

### *Commutator Cleaning and Inspection*




- Smooth the commutator surface [A] if necessary with fine emery cloth [B], and clean out the grooves.



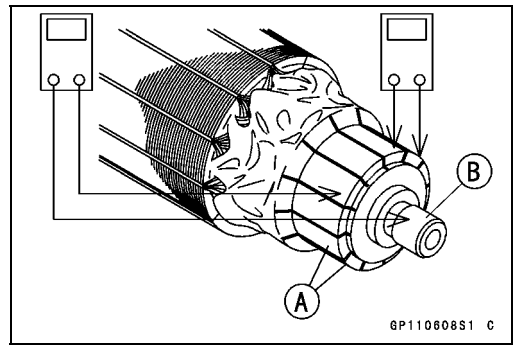

- Measure the diameter [A] of the commutator [B].

★Replace the starter motor with a new one if the commutator diameter is less than the service limit.

**Commutator Diameter**

| | |
|---|---|
| **Standard:** | **28 mm (1.10 in.)** |
| **Service Limit:** | **27 mm (1.06 in.)** |

### *Armature Inspection*




- Using the × 1 Ω hand tester range, measure the resistance between any two commutator segments [A].

**Special Tool - Hand Tester: 57001-1394**

★If there is a high resistance or no reading (∞) between any two segments, a winding is open and the starter motor must be replaced.

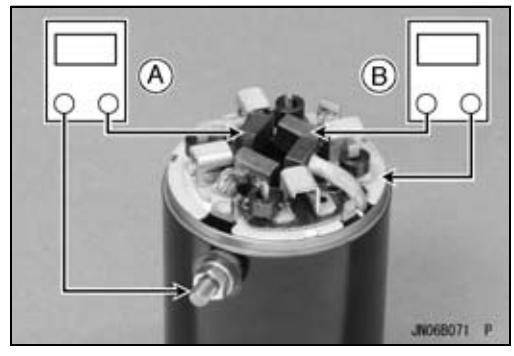
- Using the highest hand tester range, measure the resistance between the segments and the shaft [B].

★If there is any reading at all, the armature has a short and the starter motor must be replaced.

**NOTE**

○*Even if the foregoing checks show the armature to be good, it may be defective in some manner not readily detectable within the hand tester. If all other starter motor and starter motor circuit components check good, but the starter motor still does not turn over or only turns over weakly, replace the starter motor with a new one.*

### *Brush Lead Inspection*



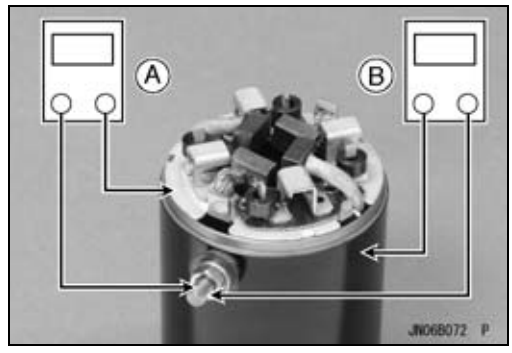

- Using the × 1 Ω hand tester range, measure the resistance as shown.
  [A] Terminal and Positive Brush
  [B] Brush Plate and Negative Brush

**Special Tool - Hand Tester: 57001-1394**

★If there is not close to zero ohms, the brush lead has an open. Replace the positive brush assembly and/or the negative brush assembly.

## Electric Starter System

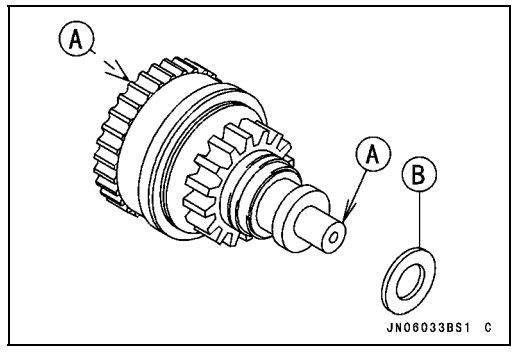
### *Brush Plate and Terminal Bolt Inspection*




- Using the highest hand tester range, measure the resistance as shown.
  [A] Terminal Bolt and Brush Plate
  [B] Terminal Bolt and Yoke

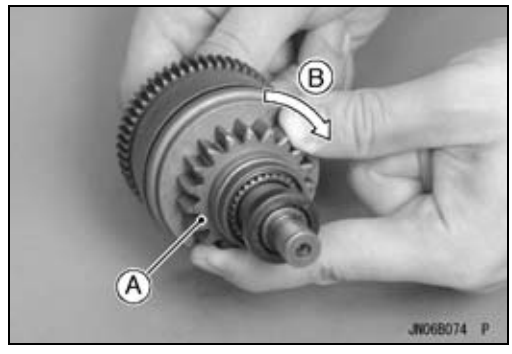
★If there is any reading, the negative brush assembly and/or positive brush assembly have a short. Replace the negative and positive brush assemblies.

### *Reduction Gear Removal/Installation*

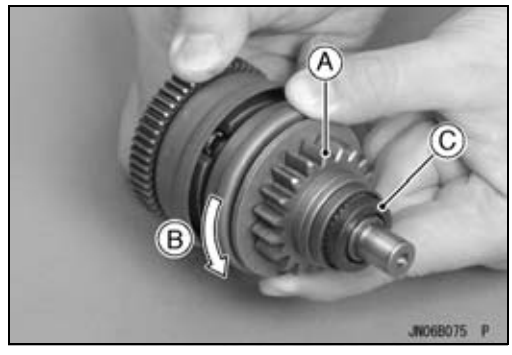



- Remove the alternator rotor (see Alternator Rotor Removal in the Engine Bottom End chapter).
- When installing the reduction gear, apply a molybdenum disulfide grease [A] to both ends of its shaft.
- Be sure to install the washer [B].

### *Reduction Gear Inspection*




- Check that the pinion gear [A] turns freely clockwise [B].

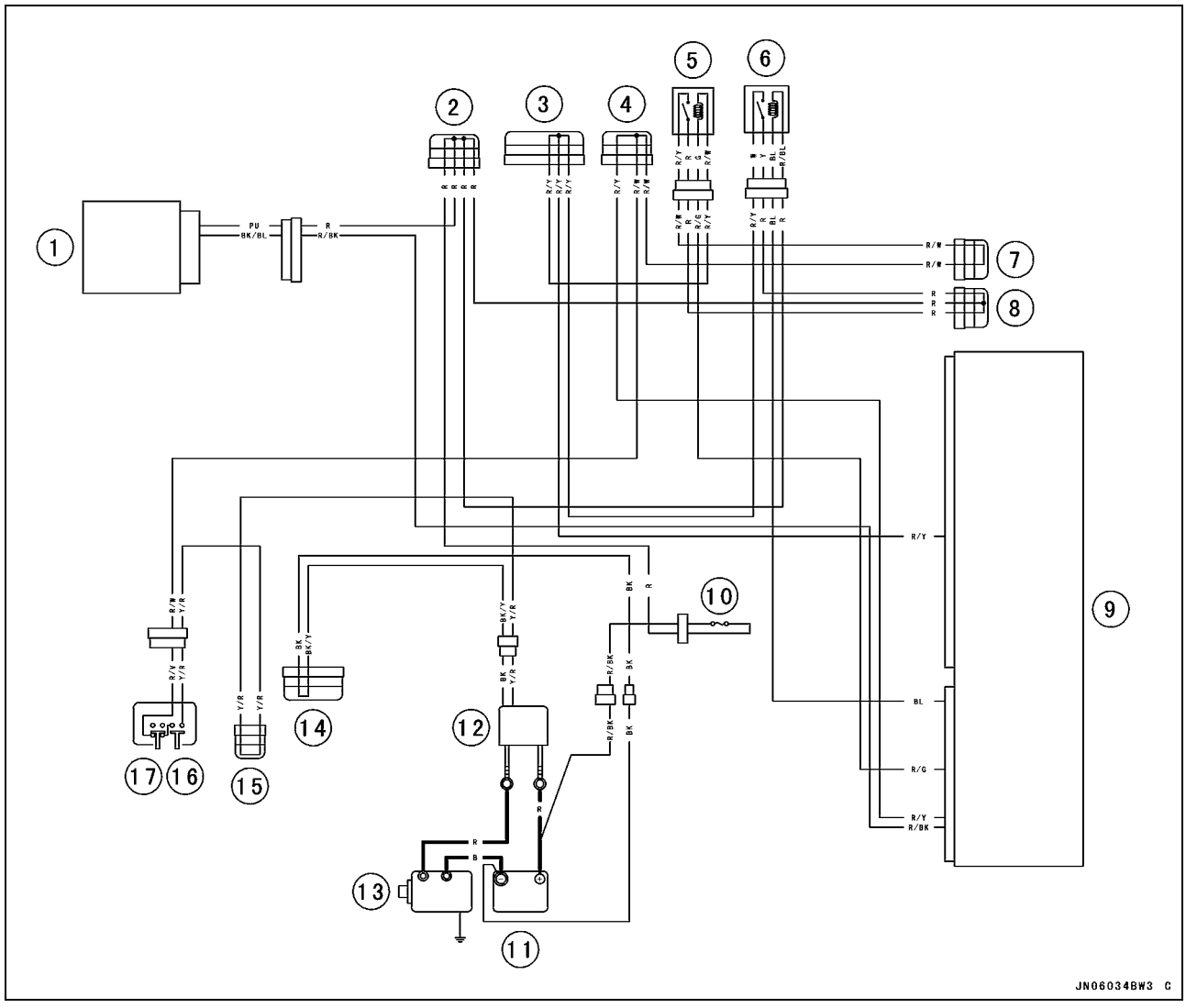



- When the pinion gear [A] turns counterclockwise [B], check that it advances along the shaft, and the gear stops against the stopper [C].
- Check that the pinion gear returns to the initial position quickly.

★If the pinion gear does not function properly, replace it.

## Electric Starter System

### Electric Starter Circuit




1. Ignition Switch
2. Joint Connector P (12 V)
3. Joint Connector R (12 V)
4. Joint Connector T (12 V)
5. ECU Main Relay
6. System Relay
7. Joint Connector D (12 V)
8. Joint Connector C (12 V)
9. ECU
10. Main Fuse 20 A
11. Battery
12. Starter Relay
13. Starter Motor
14. Joint Connector S (Ground)
15. Joint Connector X (12 V)
16. Engine Start Switch
17. Engine Stop Switch/Tether

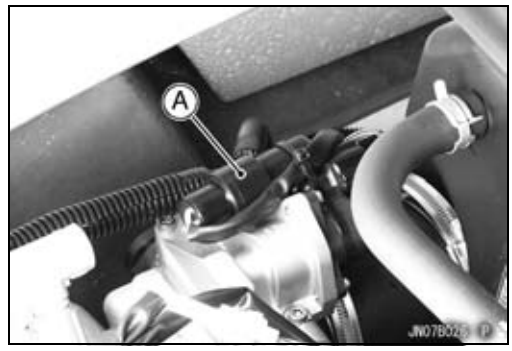
## Charging System

### *Alternator Removal/Installation*

- Refer to the Alternator Rotor Removal and Installation in the Engine Bottom End chapter.

### *Alternator Output Voltage Inspection*

- Remove:
  Seat (see Seat Removal in the Hull/Engine Hood chapter)
- Disconnect the stator coil lead connector [A].




- With the hand tester [A], check the alternator output (in circuit) according to the following table.

**Special Tool - Hand Tester: 57001-1394**

**⚠ WARNING**

**Water is a high conductor of electricity and performing an electrical circuit inspection on water could cause severe electrical shock to you. To prevent shocks, do not inspect the electrical system while the boat is in the water and do not touch the alternator output leads while the engine is running.**

***NOTICE***

**Operating the engine without cooling water for more than 15 seconds, especially at high rpm, will cause severe engine and exhaust system damage. To avoid engine damage, do not run the engine without providing sufficient cooling water.**

**Alternator Output Voltage** **at 3 000 r/min (rpm)**

| Tester Range | Connections | | Reading |
|---|---|---|---|
| | Tester (+) to | Tester (–) to | |
| 250 V AC | W lead | W lead | 48 ~ 72 V |

★If the alternator output voltage is correct, check the regulator (see Regulator/Rectifier Inspection).

★If the alternator output voltage is low, check the stator coil resistance with a digital meter according to the following table.

**Stator Coil Resistance** **at 20°C (68°F)**

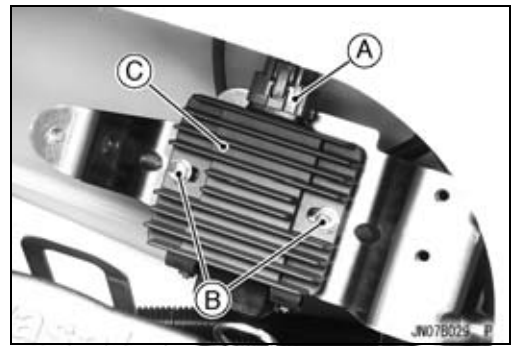
| Tester Range | Connections | | Reading |
|---|---|---|---|
| | Tester (+) to | Tester (–) to | |
| × 1 Ω | W lead | W lead | 0.432 ~ 0.648 Ω |

★If the coil has normal resistance, but the voltage check shows the charging system to be defective, then the permanent magnets in the alternator rotor have probably weakened, necessitation alternator rotor replacement.

## Charging System

### *Regulator/Rectifier Removal/Installation*

- Remove the seat (see Seat Removal in the Hull/Engine Hood chapter).
- Remove:
  Bracket Bolts [A]




- Disconnect the connector [A].
- Remove:
  Regulator/Rectifier Bolts [B]
  Regulator/Rectifier [C]

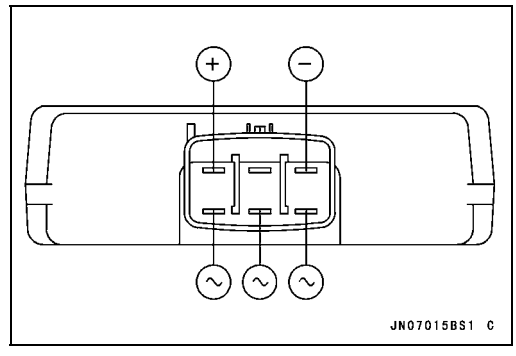
- Installation is the reverse of removal. Note the following.

○Apply a non-permanent locking agent to the bracket bolts.

○Tighten:

**Torque - Regulator/Rectifier Bolts: 7.8 N·m (0.80 kgf·m, 69 in·lb)**
**Bracket Bolts: 8.8 N·m (0.90 kgf·m, 78 in·lb)**

### *Regulator/Rectifier Inspection*




- With the hand tester set to the × 1 kΩ range, test the regulator/rectifier according the following table.

**Special Tool - Hand Tester: 57001-1394**

**Regulator/Rectifier Inspection** **Unit: kΩ**

| | Tester (+) Lead Connection | | | | | |
|---|---|---|---|---|---|---|
| | Terminal | + | ~ | ~ | ~ | − |
| (−)* | + | − | 500 ~ ∞ | 500 ~ ∞ | 500 ~ ∞ | 500 ~ ∞ |
| | ~ | 2 ~ 20 | − | 500 ~ ∞ | 500 ~ ∞ | 500 ~ ∞ |
| | ~ | 2 ~ 20 | 500 ~ ∞ | − | 500 ~ ∞ | 500 ~ ∞ |
| | ~ | 2 ~ 20 | 500 ~ ∞ | 500 ~ ∞ | − | 500 ~ ∞ |
| | − | 2 ~ 40 | 2 ~ 20 | 2 ~ 20 | 2 ~ 20 | − |

(−)*: Tester (−) lead Connection

★If any of the values obtained does not match with the above table, the regulator/rectifier must be replaced.

### *Regulator Inspection*

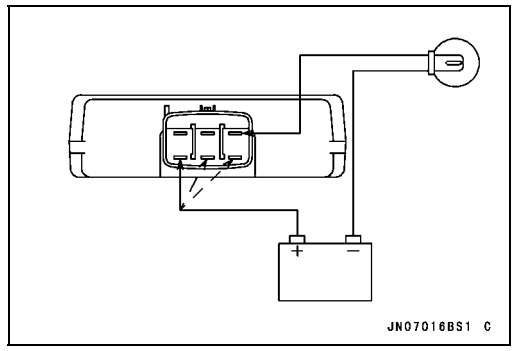
○To test the regulator out of circuit, use three 12 V batteries and a test light (12 V 3 ~6 W bulb in a socket with leads).

**NOTICE**

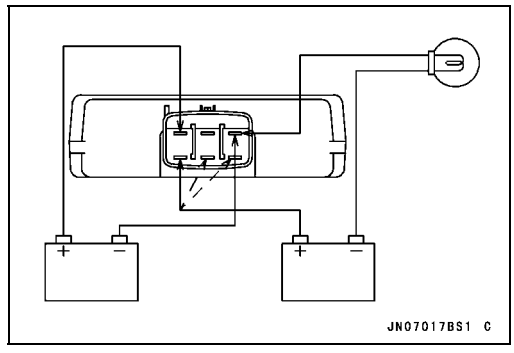
**The test light works as an indicator and also as a current limiter to protect the regulator/rectifier from excessive current. Do not use an ammeter instead of a test light.**

## Charging System

● Do the 1st step regulator circuit test.
○Connect the test light and the 12 V battery to the regulator/rectifier as shown.
○Check infinity (~) terminals respectively.
★If the test light turns on, the regulator/rectifier is defective. Replace it.
★If the test light does not turn on, continue the test.



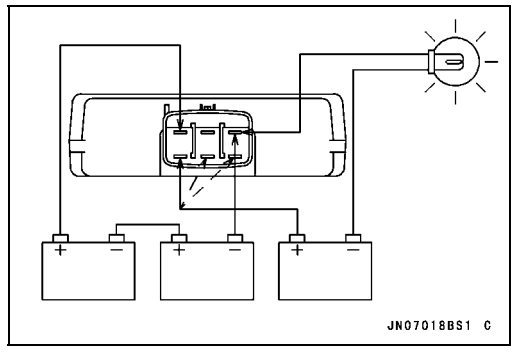

● Do the 2nd step regulator circuit test.
○Connect the test light and the 12 V battery in the same manner as specified in the “1st step regulator circuit test”.
○Apply 12 V to the positive (+) terminal.
○Check infinity (~) terminals respectively.
★If the test light turns on, the regulator/rectifier is defective. Replace it.
★If the test light does not turn on, continue the test.




● Do the 3rd step regulator circuit test.
○Connect the test light and the 12 V battery in the same manner as specified in the “2nd step regulator circuit test”.
○Momentarily apply 24 V to the positive (+) terminal by adding a 12 V battery.
○Check infinity (~) terminals respectively.

***NOTICE***

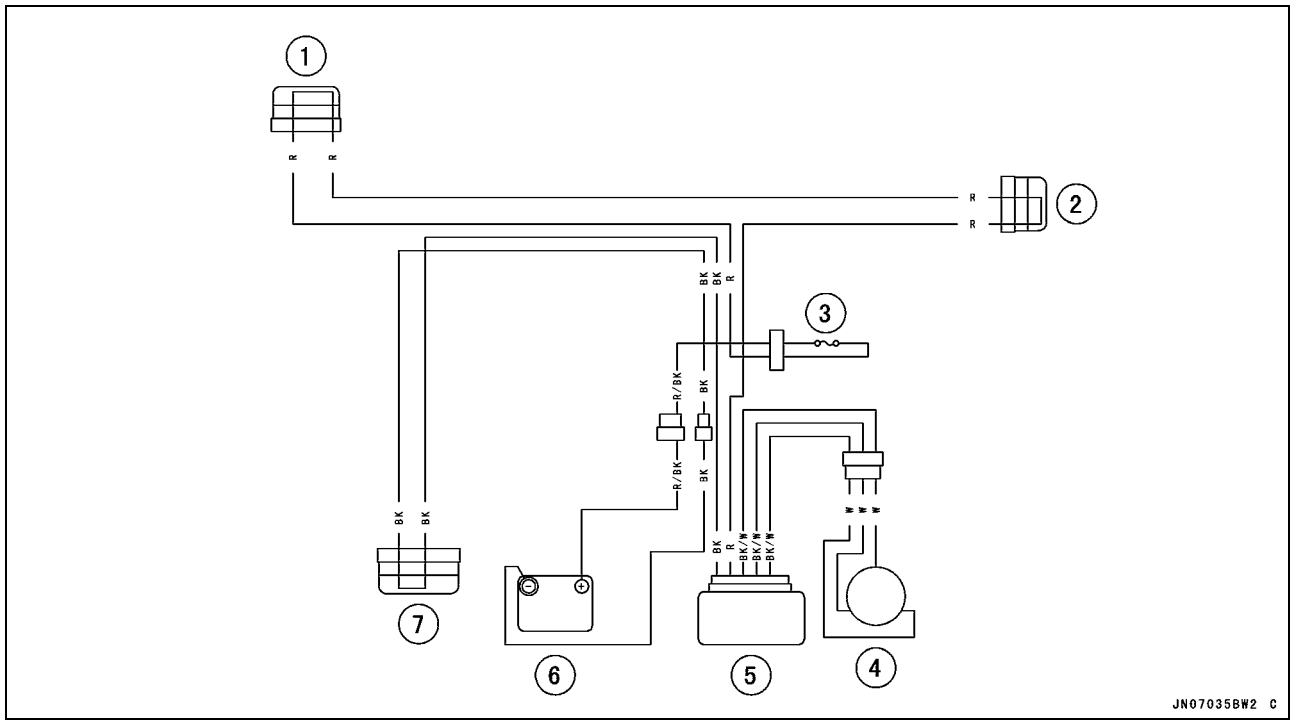
**If more than 24 volts is applied or 24 volts applied for more than a few seconds, the regulator/rectifier may be damaged. To prevent damage to the regulator/rectifier, do not apply more than 24 volts, and do not apply 24 volts for more than a few seconds.**




★If the test light does not light when 24 V is applied momentarily to the positive (+) terminal, the regulator/rectifier is defective. Replace it.
★If the regulator/rectifier passes all the tests described, it may still be defective. If the charging system still does not work properly after checking all the components and the battery, test the regulator/rectifier by replacing it with a known good unit.
● Repeat the test for another regulator/rectifier.

## Charging System

### Charging System Circuit




1. Joint Connector P (12 V)
2. Joint Connector C (12 V)
3. Main Fuse 20 A
4. Alternator
5. Regulator/Rectifier
6. Battery
7. Joint Connector S (Ground)

## Ignition System

**⚠ WARNING**

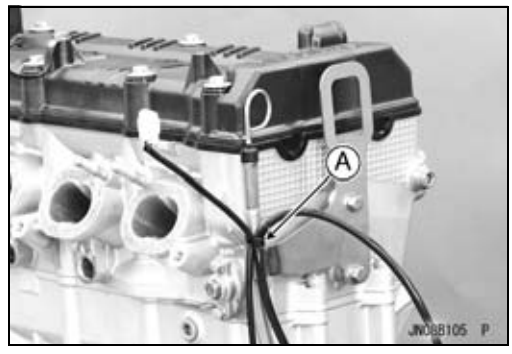
**The ignition system produces extremely high voltage. Do not touch the spark plugs, ignition coils, or spark plug high-tension leads while the engine is running, or you could receive a severe electrical shock.**

***NOTICE***

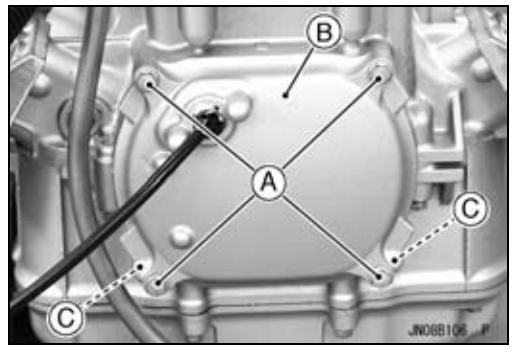
**Disconnecting the battery cables or any other electrical connections when the ignition switch is on or while the engine is running can damage the ECU (Electronic Control Unit). Do not disconnect the battery cables or any other electrical connections when the ignition switch is on, or while the engine is running.**
**Installing the battery cables backwards can damage the diodes and ECU. Be sure to install the cables properly.**

### *Crankshaft Sensor Removal*

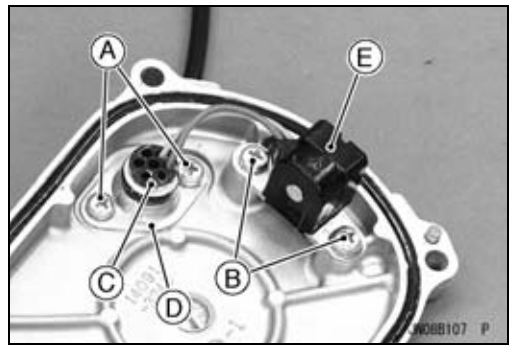
- Remove:
  Engine (see Engine Removal in the Engine Removal/Installation chapter)
- Cut the band [A].




- Remove:
  Crankshaft Sensor Cover Bolts [A]
  Crankshaft Cover [B]
  Dowel Pins [C]

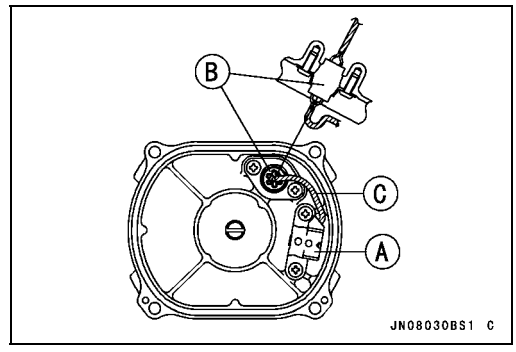



- Remove:
  Rubber Grommet Holder Screws [A]
  Crankshaft Sensor Screws [B]
  Rubber Grommet [C] and Holder [D]
  Crankshaft Sensor [E]



## Ignition System

### *Crankshaft Sensor Installation*



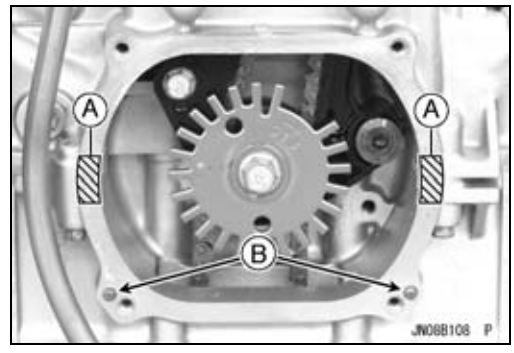

- Run the sensor lead through the cover hole.
- Install the crankshaft sensor [A].
- Apply a non-permanent locking agent to the sensor screws.
- Tighten:

**Torque - Crankshaft Sensor Screws: 4.5 N·m (0.46 kgf·m, 40 in·lb)**

- Install the rubber grommet [B] in the sensor cover hole.
- Run the sensor lead [C] as shown in the figure.
- Apply water-resistance grease to the grommet outside.
- Apply a non-permanent locking agent to the grommet holder screws.
- Tighten:

**Torque - Rubber Grommet Holder Screws: 4.5 N·m (0.46 kgf·m, 40 in·lb)**

- Replace the crankshaft sensor cover O-ring with a new one.
- Apply grease to the new O-ring and install it.



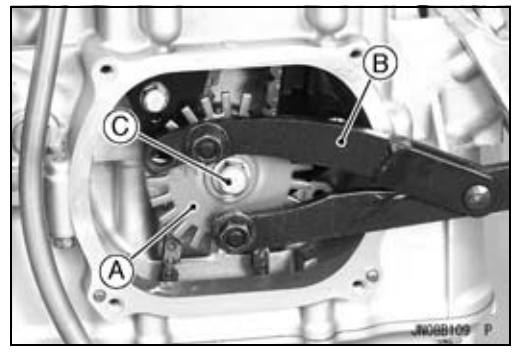

- Apply sealant to the crankcase halves mating surface [A] as shown in the figure.

**Sealant - Liquid Gasket, TB1211F: 92104-0004**

- Install:
  Dowel Pins [B]
  Crankshaft Sensor Cover
- Tighten:

**Torque - Crankshaft Sensor Cover Bolts: 7.8 N·m (0.80 kgf·m, 69 in·lb)**

### *Timing Rotor Removal*




- Remove the crankshaft sensor cover (see Crankshaft Sensor Removal).
- Hold the timing rotor [A] steady with the flywheel & pulley holder [B] and unscrew the bolt [C].

**Special Tools - Holder Attachment: 57001-1547**
**Flywheel & Pulley Holder: 57001-1605**

### *Timing Rotor Installation*

- Fit the rotor to the crankshaft.

○Align the pin [A] and groove [B] of the timing rotor, and face the flat side (marked side) to the outside.

- Apply a non-permanent locking agent to the rotor bolt.
- Tighten:

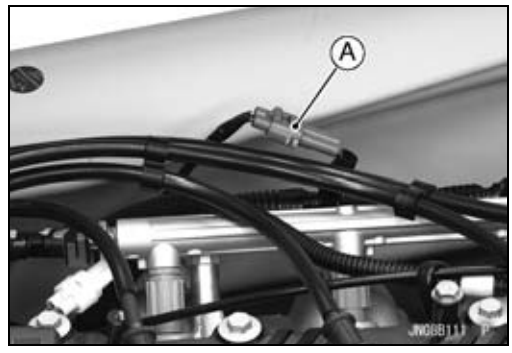
**Torque - Timing Rotor Bolt: 20 N·m (2.0 kgf·m, 15 ft·lb)**

**Special Tools - Holder Attachment: 57001-1547**
**Flywheel & Pulley Holder: 57001-1605**

- Install the crankshaft sensor cover (see Crankshaft Sensor Cover Installation).

## Ignition System

### *Crankshaft Sensor Inspection*




- Remove:
  Seat (see Seat Removal in the Hull/Engine Hood chapter)
- Disconnect the crankshaft sensor lead connector (Blue, 2-pin) [A].

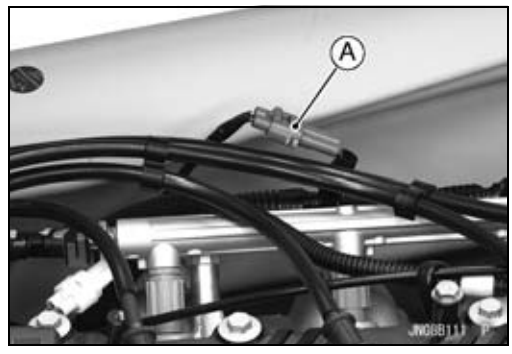
- Set the hand tester [A] to the × 100 Ω range, and connect it to the crankshaft sensor lead terminals (G and BL).

**Special Tools - Hand Tester: 57001-1394**
**Needle Adapter Set: 57001-1457 [B]**

**Crankshaft Sensor Resistance**
**Standard: 408 ~ 612 Ω at 20°C (68°F)**

★If there is more resistance than the standard value, the sensor has an open lead and must be replaced. Much less than this resistance means the sensor is shorted, and must be replaced.

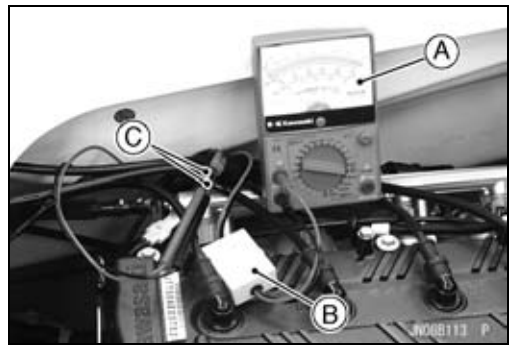
### *Crankshaft Sensor Peak Voltage Inspection*




**NOTE**

○*Be sure the battery is fully charged.*
○*Using the peak voltage adapter is a more reliable way to determine the condition of the crankshaft sensor than crankshaft sensor internal resistance measurements.*

- Disconnect the crankshaft sensor lead connector [A].




- Set the hand tester [A] to the × DC 10 V range, and connect the peak voltage adapter [B].

**Special Tools - Hand Tester: 57001-1394**
**Peak Voltage Adapter: 57001-1415**
**Type: KEK-54-9-B**
**Needle Adapter Set: 57001-1457 [C]**

**Connections:**

| Crankshaft Sensor Lead Connector [C] | | Peak Voltage Adapter | | Hand Tester |
|---|---|---|---|---|
| BL | ← | BK | → | (–) |
| G | ← | R | → | (+) |

- Insert the ignition key in the ignition switch to turn it on and insert the lanyard key under the stop button.

## Ignition System

- Pushing the starter button, turn the engine 4 ~ 5 seconds to measure the crankshaft sensor peak voltage.

○Do not operate the starter for longer than 5 seconds. Wait 15 seconds before using it again.

- Repeat the measurement 5 or more times.

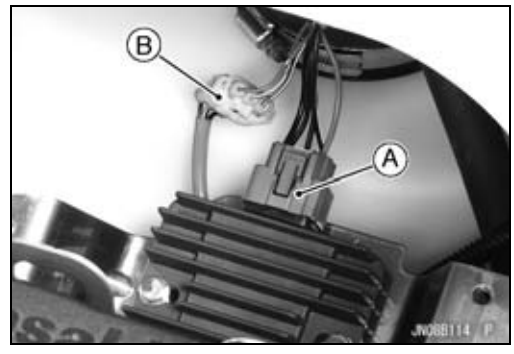
**Crankshaft Sensor Peak Voltage**
**Standard: 2.5 V or more**

★If the tester reading is not specified one, check the crankshaft sensor (see Crankshaft Sensor Inspection).

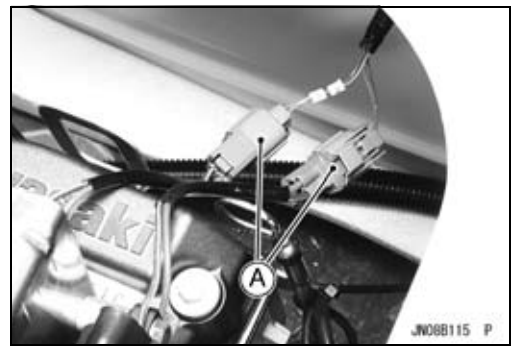
### *Ignition Coil Removal*

- Remove:
  Seat (see Seat Removal in the Hull/Engine Hood chapter)
- Remove the bracket bolts [A].

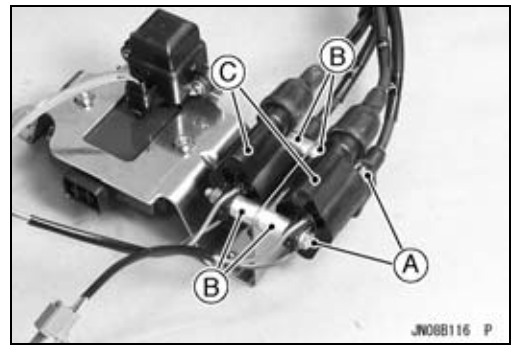
- Disconnect:
  Regulator/Rectifier Connector [A]
  Vehicle-down Sensor Lead Connector [B]




- Disconnect the ignition coil primary lead connectors [A].
- Take the spark plug caps off the engine.

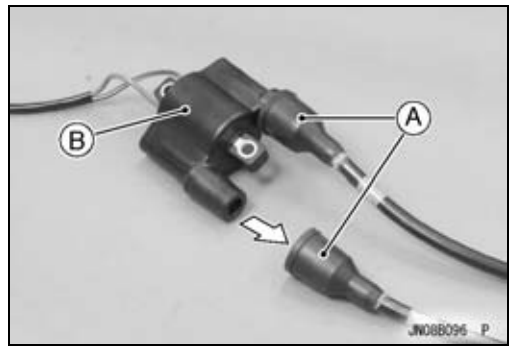



- Remove:
  Bolts [A] and Nuts
  Collars [B]
  Ignition Coils [C]



## Ignition System

- Take the spark plug leads [A] off the ignition coil [B].



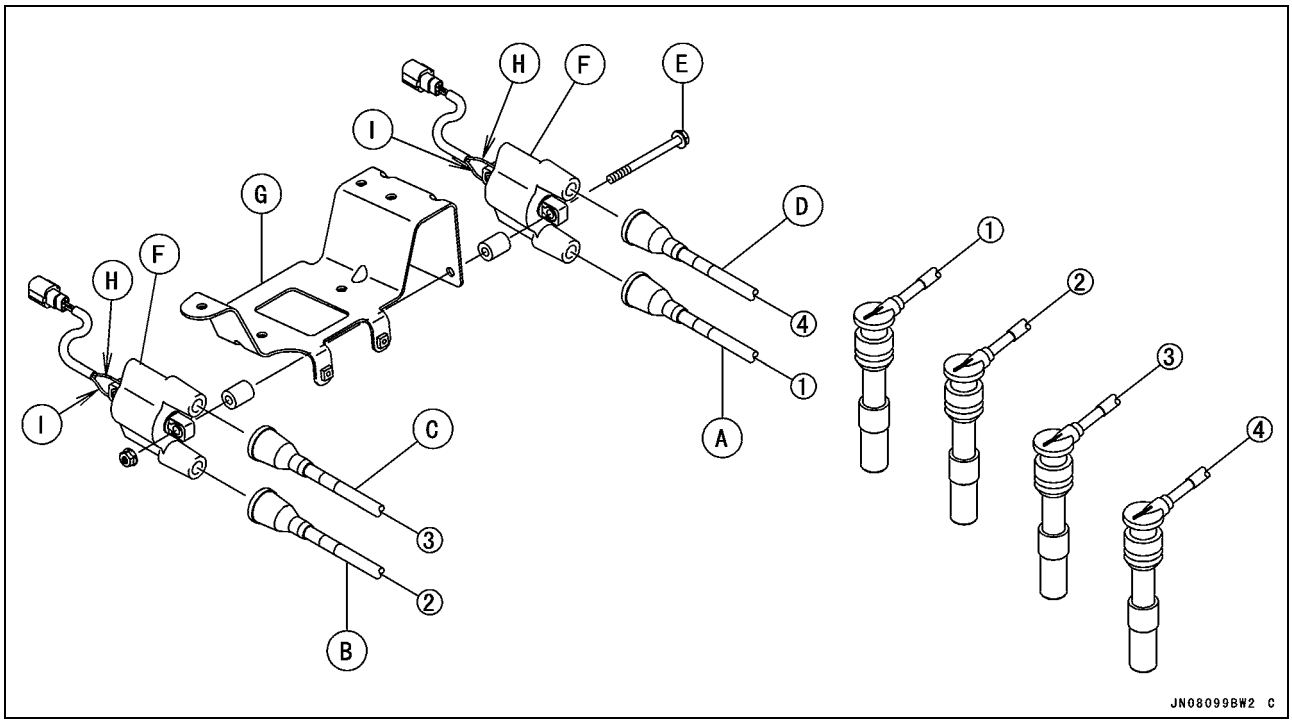

### *Ignition Coil Installation*

- Lubricate the spark plug leads with the penetrating rust inhibitor.
- Connect the spark plug lead to each ignition coil as follows.
  #1 Spark Plug Lead Length 340 mm (13.4 in.) [A]
  #2 Spark Plug Lead Length 450 mm (17.7 in.) [B]
  #3 Spark Plug Lead Length 540 mm (21.3 in.) [C]
  #4 Spark Plug Lead Length 600 mm (23.6 in.) [D]
- Apply a non-permanent locking agent to the ignition coil mounting bolts [E].
- Install the ignition coils [F] to the bracket [G].
  BK/W Leads [H]
  R Leads [I]
- Tighten:

**Torque - Ignition Coil Mounting Bolts: 8.8 N·m (0.90 kgf·m, 78 in·lb)**

- Apply a non-permanent locking agent to the bracket bolts.
- Tighten:

**Torque - Bracket Bolts: 8.8 N·m (0.90 kgf·m, 78 in·lb)**



## Ignition System

### *Ignition Coil Inspection*

**Measuring arcing distance**

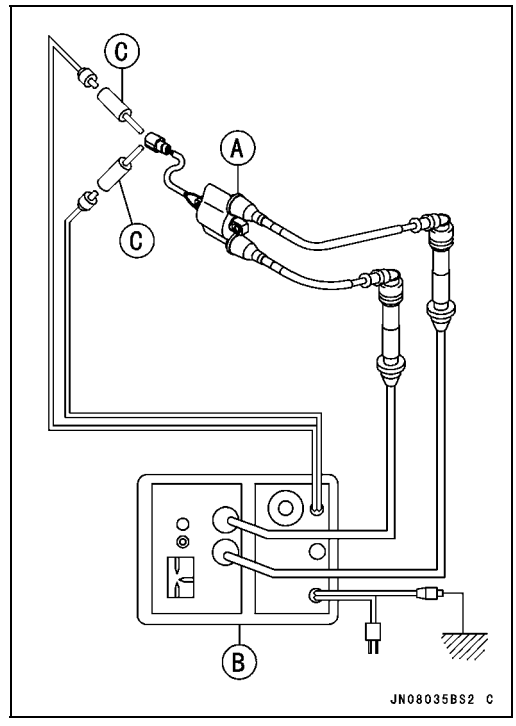
The most accurate test for determining the condition of the ignition coil is made by measuring arcing distance.

- Remove the ignition coil (see Ignition Coil Removal).
- Connect the ignition coil [A] (with the spark plug cap left installed on the spark plug lead) to the tester [B], and measure the arcing distance.

Auxiliary Wires [C]

**⚠ WARNING**

**To avoid extremely high voltage shocks, do not touch the coil body or leads.**




**3 Needle Arcing Distance**
**Standard: 7 mm (0.28 in.) or more**

★If the distance reading is less than the specified value, the ignition coil or spark plug cap is defective.

- To determine which part is defective, measure the arcing distance again with the spark plug leads removed from the ignition coil (see Ignition Coil Removal).

★If the arcing distance is subnormal as before, the trouble is with the ignition coil itself. If the arcing distance is now normal, the trouble is with the spark plug lead.

**Measuring coil resistance**

If the Coil Tester is not available, the coil can be checked for a broken or badly shorted winding with a tester. However, a tester can not detect layer shorts and shorts resulting from insulation breakdown under high voltage.

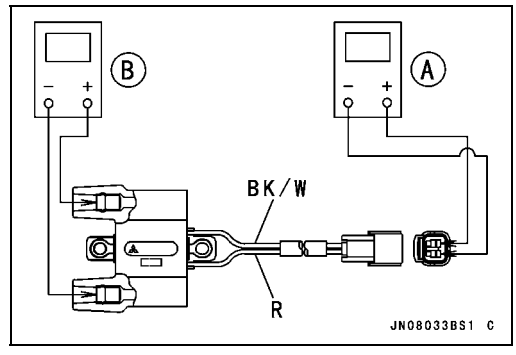
- Disconnect the primary leads from the coil terminals.
- Measure the primary winding resistance as follows [A].

**Special Tool - Hand Tester: 57001-1394**

○Connect the hand tester between the coil terminals.
○Set the tester to the × 1 Ω range, and read the tester.

- Measure the secondary winding resistance as follows [B].

○Remove the spark plug leads (see Ignition Coil Removal).
○Connect the hand tester between the secondary lead terminals.
○Set the tester to the × 1 kΩ range, and read the tester.




**Winding Resistance**
**Standard: Primary windings 1.44 ~ 2.16 Ω**
**Secondary windings 11.76 ~ 17.64 kΩ**

★If the hand tester does not read as specified, replace the coil.

★If the tester reads are as specified, the ignition coil windings are probably good. However, if the ignition system still does not perform as it should after all other components have been checked, test replace the coil with one known to be good.

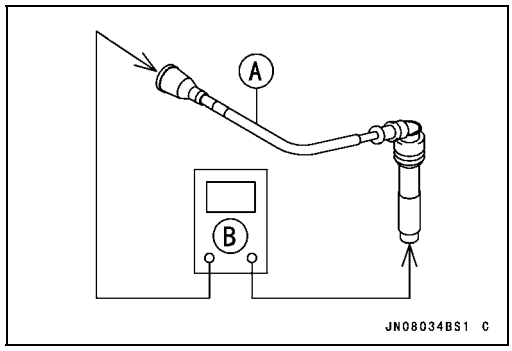
## Ignition System

**Measuring spark plug lead resistance**

- Check the spark plug lead [A] for visible damage.

★If the spark plug lead is damaged, replace the spark plug lead.

- Measure the lead resistance with the hand tester [B].




**Spark Plug Lead Resistance**

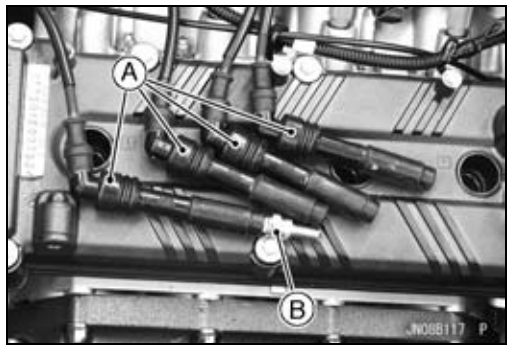
| | | |
|---|---|---|
| **Standard:** | **(#1)** | **2.80 ~ 4.79 kΩ** |
| | **(#2)** | **3.55 ~ 6.07 kΩ** |
| | **(#3)** | **4.16 ~ 7.11 kΩ** |
| | **(#4)** | **4.57 ~ 7.81 kΩ** |

★If the hand tester does not read as specified, replace the lead.

### *Ignition Coil Primary Peak Voltage Inspection*

**NOTE**

○*Be sure the battery is fully charged.*




- Remove the seat (see Seat Removal in the Hull/Engine Hood chapter).
- Take the spark plug caps [A] but do not remove the spark plugs.
- Install new spark plug [B] into the spark plug cap.

- Connect the peak voltage adapter [A] to the hand tester [B] and the harness adapter [C].

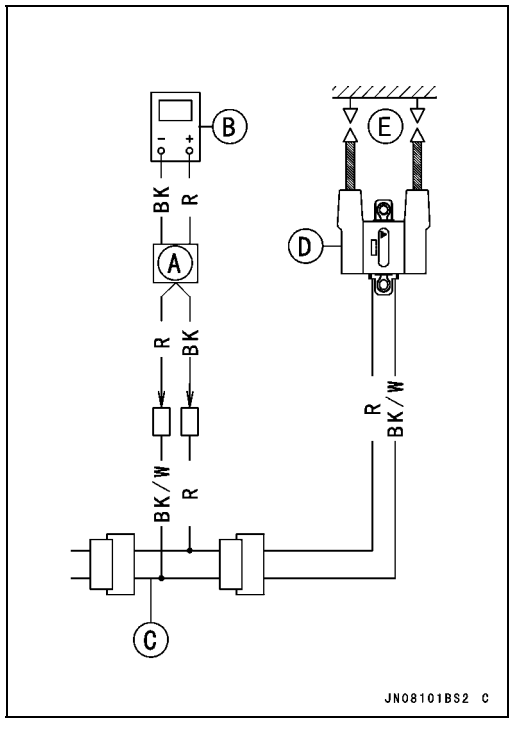
**Hand Tester Range: DC 1 000 V**

**Special Tools - Hand Tester: 57001-1394**
**Peak Voltage Adapter: 57001-1415**
**Type: KEK-54-9-B**
**Harness Adapter: 57001-1562**

**Primary Lead Connections:**

| Harness Aapter | | Peak Voltage Adapter | | Hand Tester |
|---|---|---|---|---|
| **R** | ← | **BK** | → | **(–)** |
| **BK/W** | ← | **R** | → | **(+)** |

Ignition Coil [D]
Spark Plug [E]




**⚠ WARNING**

**To avoid extremely high voltage shocks, do not touch the spark plugs or tester connections.**

## Ignition System

- Insert the ignition key in the ignition switch to turn it on and insert the lanyard key under the stop button.
- Ground the new spark plug [A] onto the engine.
- Pushing the starter button, turn the engine 4 ~ 5 seconds to measure the primary peak voltage.

○Do not operate the starter for longer 5 seconds. Wait 15 seconds before using it again.

- Repeat the measurements 5 times for one ignition coil.

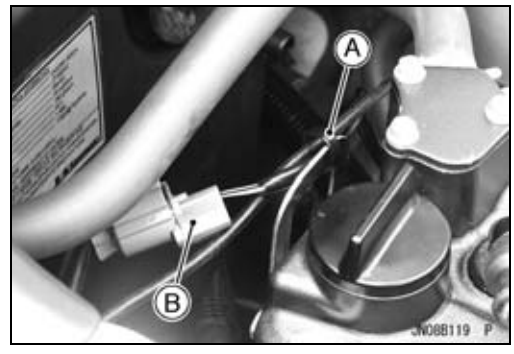
**Ignition Coil Primary Peak Voltage**
**Standard: 250 V or more**

- Repeat the test for the other ignition coil.

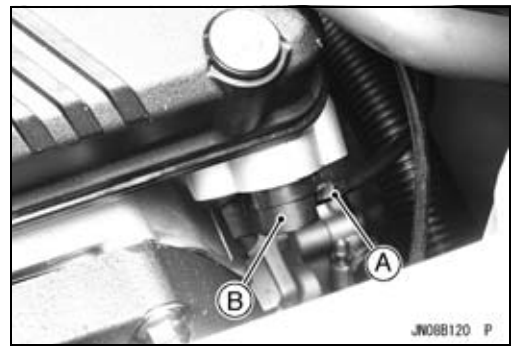
★If the reading is less than the specified value, check the following:
Ignition Coils (see Ignition Coil Inspection )
Crankshaft Sensor (see Crankshaft Sensor Inspection )

★If the ignition coils and crankshaft sensor are normal, check the ECU (see ECU Power Supply Inspection in the Fuel System (DFI) chapter).

### *Camshaft Position Sensor Removal/Installation*




- Remove:
Seat (see Seat Removal in the Hull/Engine Hood chapter)
- Cut the band [A].
- Disconnect the camshaft position sensor lead connector [B].



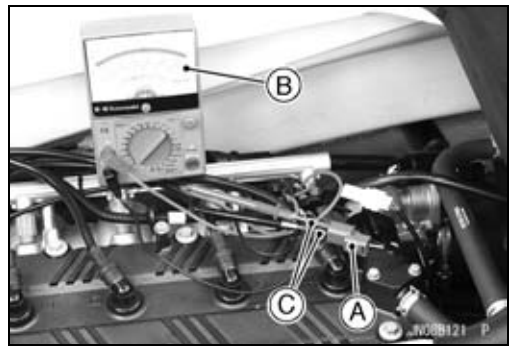

- Remove:
Camshaft Position Sensor Bolt [A]
Camshaft Position Sensor [B]

- Installation is the reverse of removal. Note the following.

○Replace the camshaft position sensor O-ring with a new one.
○Apply grease to the new O-ring.
○Apply a non-permanent locking agent to the camshaft position sensor bolt.
○Tighten:

**Torque - Camshaft Position Sensor Bolt: 10 N·m (1.0 kgf·m, 89 in·lb)**

### *Camshaft Position Sensor Inspection*




- Remove:
  Seat (see Seat Removal in the Hull/Engine Hood chapter)
  Camshaft Position Sensor Lead Connector [A] (Disconnect)
- Set the hand tester [B] to the × 100 Ω range and connect it to the yellow and black leads in the connector.

**Special Tools - Hand Tester: 57001-1394**
**Needle Adapter Set: 57001-1457 [C]**

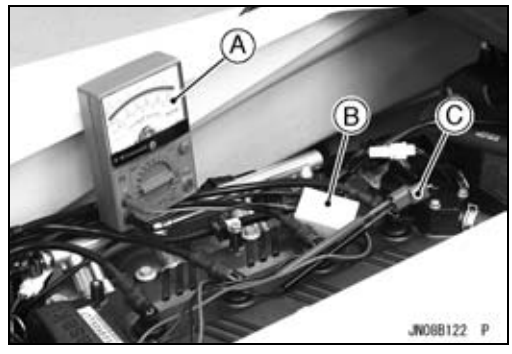
**Camshaft Position Sensor Resistance**
**Standard: 400 ~ 460 Ω at 20°C (68°F)**

★If there is more resistance than the specified value, the sensor coil has an open lead and must be replaced. Much less than this resistance means the sensor coil is shorted, and must be replaced.

- Using the highest resistance range of the tester, measure the resistance between the camshaft position sensor leads and chassis ground.

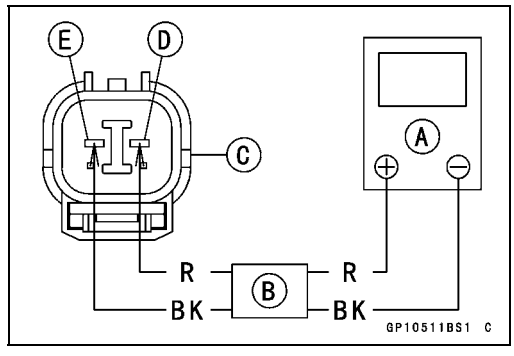
★Any tester reading less than infinity (∞) indicates a short, necessitating replacement of the camshaft position sensor.

### *Camshaft Position Sensor Peak Voltage Inspection*




- Disconnect the camshaft position sensor lead connector (see Camshaft Position Sensor Removal).
- Set the hand tester [A] to the DC 2.5 V range, and connect it peak voltage adapter [B].

**Special Tools - Hand Tester: 57001-1394**
**Peak Voltage Adapter: 57001-1415**
**Type: KEK-54-9-B**
**Needle Adapter Set: 57001-1457**




- Connect the adapter to the terminals of the camshaft position sensor lead connector [C].

**Connections:**

| Camshaft Position Sensor Lead Connector | | Peak Voltage Adapter | | Hand Tester |
|---|---|---|---|---|
| BK [D] | ← | R | → | (+) |
| Y [E] | ← | BK | → | (–) |

## Ignition System

- Insert the ignition key in the ignition switch to turn it on and insert the lanyard key under the stop button.
- Pushing the starter button, turn the engine 4 ~ 5 seconds to measure the peak voltage.

○Do not operate the starter for longer than 5 seconds. Wait 15 seconds before using it again.

- Repeat the measurements 5 times or more times.

**Camshaft Position Sensor Peak Voltage**
**Standard: 0.4 V or more**

★If the reading is less than the standard, inspect the camshaft position sensor (see Camshaft Position Sensor Inspection).

### *IC Igniter Inspection*

○The igniter is built in the ECU.

- Refer to the following items.
  Ignition System Troubleshooting (see Ignition System Troubleshooting)
  ECU Power Supply Inspection (see ECU Power Supply Inspection in the Fuel System (DFI) chapter)

***NOTICE***

**Disconnecting the battery cables or any other electrical connections when the ignition switch is on or while the engine is running can damage the igniter in the ECU (Electronic Control Unit). Do not disconnect the battery cables or any other electrical connections when the ignition switch is on, or while the engine is running.**

### *Spark Plug Removal*

- Refer to the Spark Plug Inspection in the Periodic Maintenance chapter.

### *Spark Plug Installation*

- Refer to the Spark Plug Inspection in the Periodic Maintenance chapter.

### *Spark Plug Inspection*

- Refer to the Spark Plug Inspection in the Periodic Maintenance chapter.

### *Spark Plug Adjustment*

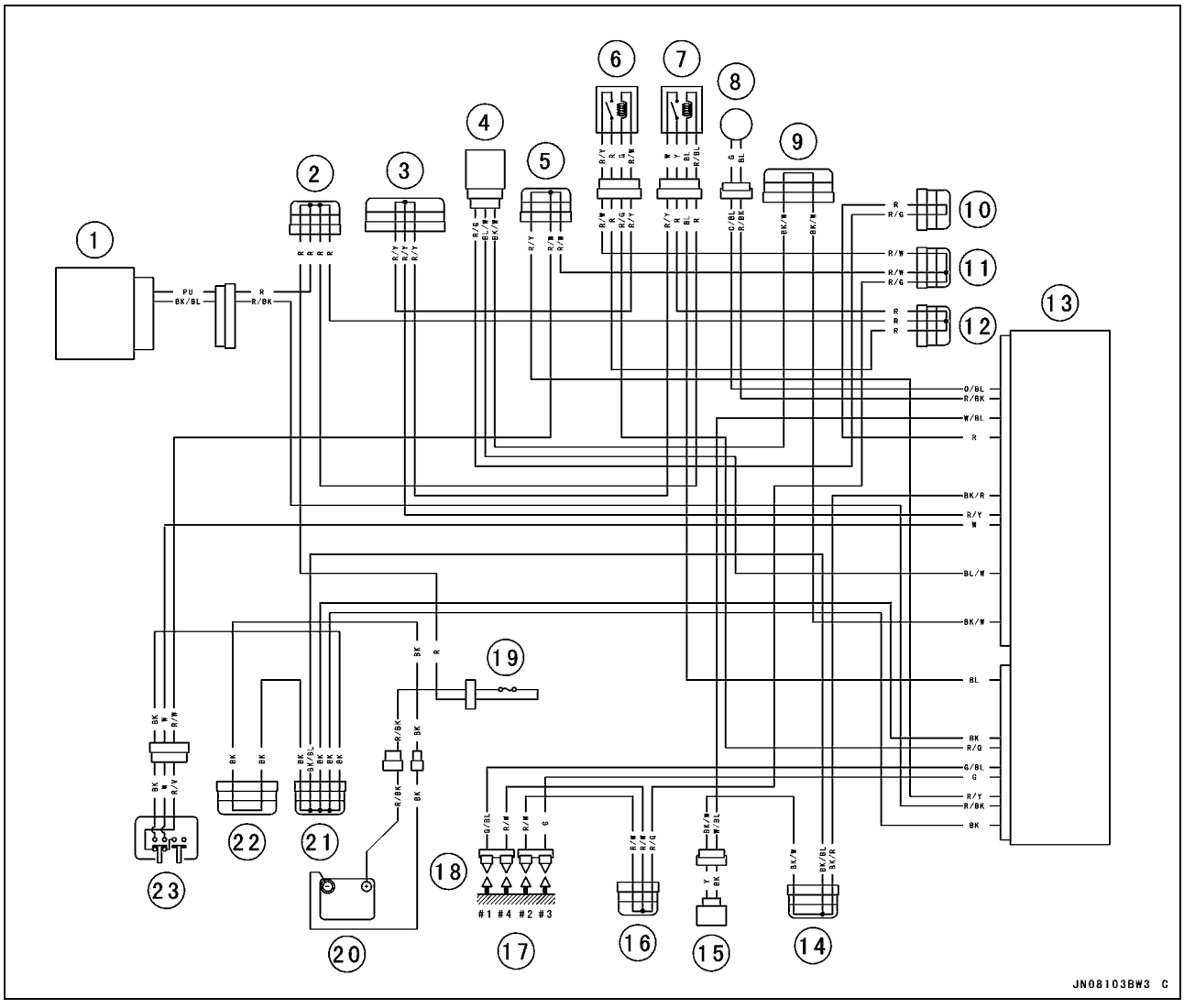
- Refer to the Spark Plug Inspection in the Periodic Maintenance chapter.

### *Spark Plug Cleaning*

- Refer to the Spark Plug Inspection in the Periodic Maintenance chapter.

## Ignition System

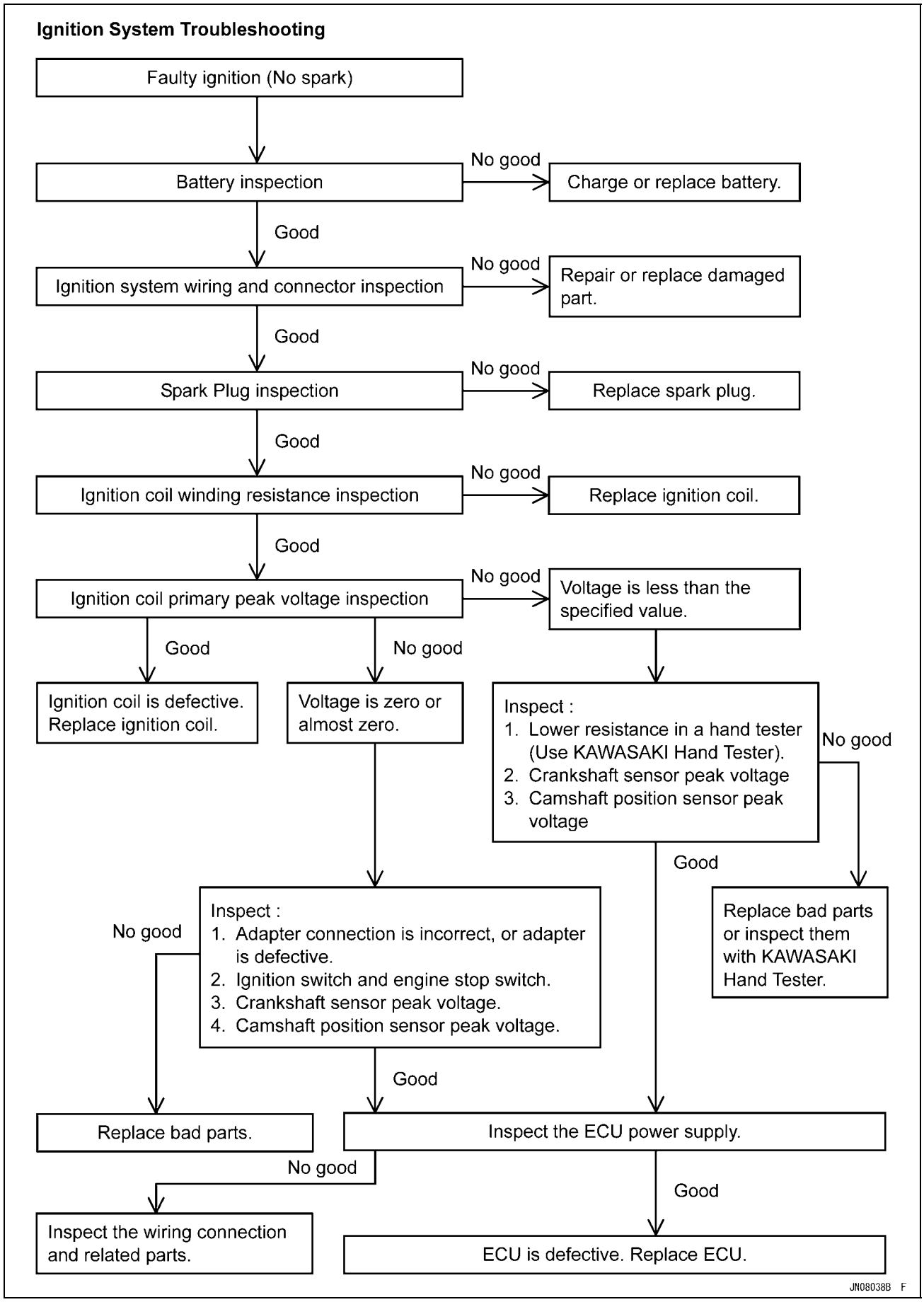
### Ignition System Circuit




1. Ignition Switch
2. Joint Connector P (12 V)
3. Joint Connector R (12 V)
4. Vehicle-down Sensor
5. Joint Connector T (12 V)
6. ECU Main Relay
7. System Relay
8. Crankshaft Sensor
9. Joint Connector B (Ground)
10. Joint Connector F (5 V)
11. Joint Connector D (12 V)
12. Joint Connector C (12 V)
13. ECU
14. Joint Connector E (Ground)
15. Camshaft Position Sensor
16. Joint Connector M (12 V)
17. Spark Plugs
18. Ignition Coils
19. Main Fuse 20 A
20. Battery
21. Joint Connector Y (Ground)
22. Joint Connector S (Ground)
23. Engine Stop Switch/Tether

## Ignition System

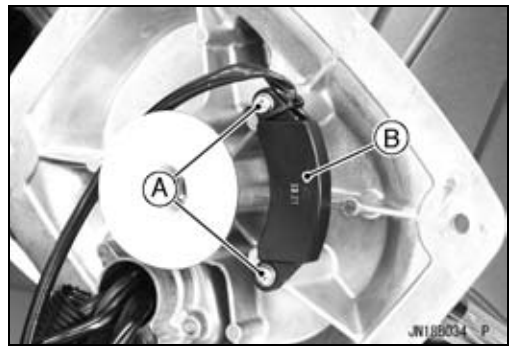
### Ignition System Troubleshooting



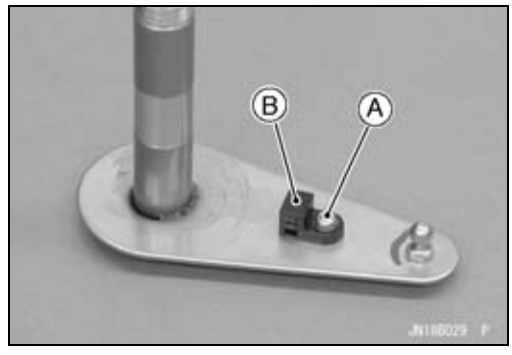
### *Steering Position Sensor and Magnet Removal*

- Remove:
  Front Access Cover (see Front Access Cover Removal in the Hull/Engine Hood chapter)
- Disconnect the steering position sensor lead connector [A].

- Remove:
  Steering Shaft (see Steering Removal in the Steering chapter)
  Steering Position Sensor Mounting Screws [A]
  Steering Position Sensor [B]




- Remove:
  Magnet Mounting Screw [A]
  Magnet [B]

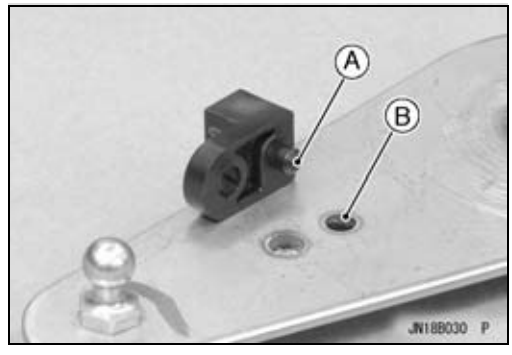



### *Steering Position Sensor and Magnet Installation*

- Install the magnet.

○Fit the projection [A] and the hole [B].

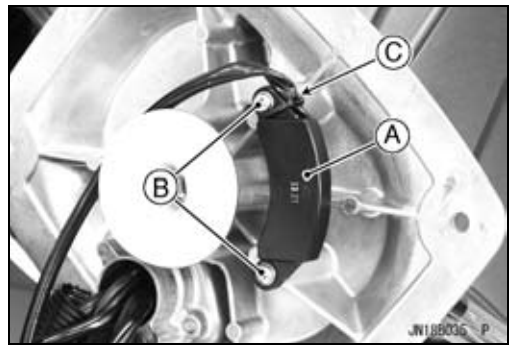
- Apply a non-permanent locking agent to the magnet mounting screw.
- Tighten the magnet mounting screw.




- Install the steering position sensor [A].
- Apply a non-permanent locking agent to the steering position sensor mounting screws [B].
- Tighten the steering position sensor mounting screws.
- Install the band [C].

○Hold the steering position sensor and its lead.

- Install the steering shaft and the steering shaft nut (see Steering Installation in the Steering chapter).



## Kawasaki Smart Steering (KSS) System

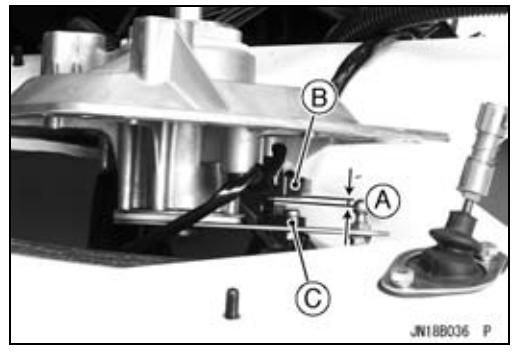
### *Kawasaki Smart Steering System Inspection*

- Inspect the smart steering system with the watercraft in the water.
- Center the handlebar in the straight-ahead position .
- Squeeze the throttle lever and allow it to approx. 4 000 r/min (rpm) or above for 4 seconds or more.
- Release the throttle lever.
- Within 1 second, turn the handlebar all the way to the left or right and check the engine speed increases to approx. 3 300 r/min (rpm), and then decreases to approx. 2 600 r/min (rpm).
- Center the handlebar in the straight-ahead position, and check the engine speed decreases to an idle speed.

★If the Kawasaki Smart Steering system does not operate normally, inpsect the steering position sensor clearance.

### *Steering Position Sensor Clearance Inspection*

- Take the steering holder off the hull (see Steering Removal in the Steering chapter).
- Check the clearance [A] between the steering position sensor [B] and the magnet [C] with feeler gauge.




**Steering Position Sensor Clearance**
**Standard: 0.5 ~ 1.5 mm (0.02 ~ 0.06 in.)**

★If the clearance is the specified value but the smart steering system does not work, inspect steering position sensor input voltage (see Steering Position Sensor Input Voltage Inspection).

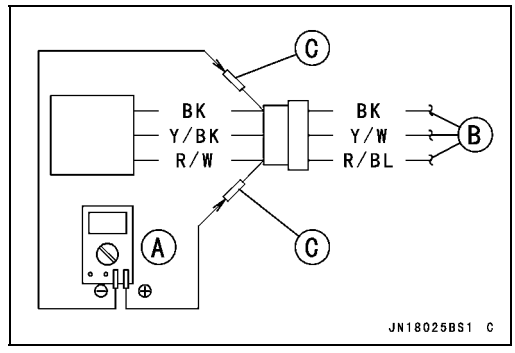
★If necessary, adjust the steering shaft nut (see Steering Installation in the Steering chapter).

### *Steering Position Sensor Input Voltage Inspection*

**NOTE**

○*Be sure the battery is fully charged.*

- Remove the front access cover (see Front Access Cover Removal in the Hull/Engine Hood chapter).
- Connect a digital meter [A] to the steering position sensor lead connector [B] with the needle adapter set [C].




**Special Tool - Needle Adapter Set: 57001-1457**

**Connections to Steering Position Sensor Lead Connector**
**Digital Meter (+) → R/W (main harness R/BL)**
**Digital Meter (–) → BK (main harness BK)**

- Insert the ignition key in the ignition switch to turn it on.
- Center the steering shaft in the straight-ahead position.
- Measure the input voltage.

**Steering Position Sensor Input Voltage**
**Standard: Battery Voltage**

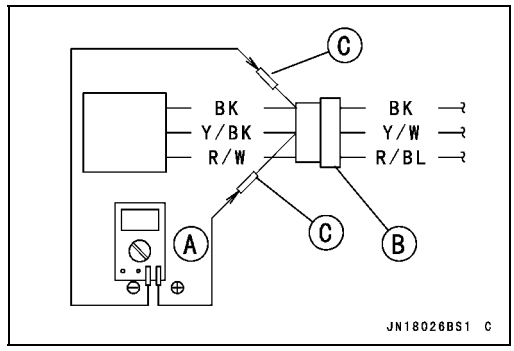
- Remove the ignition key.

★If the reading is the standard, inspect the steering position sensor output voltage (see Steering Position Sensor Output Voltage Inspection).

★If the reading is out of the standard, check the following.
Main Fuse 20 A (see Fuse Inspection)
Power Source Wiring (see Steering Position Sensor Circuit)

## Kawasaki Smart Steering (KSS) System

### *Steering Position Sensor Output Voltage Inspection*




**NOTE**

○*Be sure the battery is fully charged.*

- Connect a digital meter [A] to the steering position sensor lead connector [B] with the needle adapter set [C].

**Special Tool - Needle Adapter Set: 57001-1457**

**Connections to Steering Position Sensor Lead Connector**
**Digital Meter (+) → Y/BK (main harness Y/W)**
**Digital Meter (–) → BK (main harness BK)**

- Insert the ignition key in the ignition switch to turn it on.
- Turn the steering shaft fully left or right.
- Measure the output voltage.

**Steering Position Sensor Output Voltage**
**Standard: Approx. 0 V**

**NOTE**

○*When the steering shaft is centered in straight-ahead position, the output voltage standard value is battery voltage.*

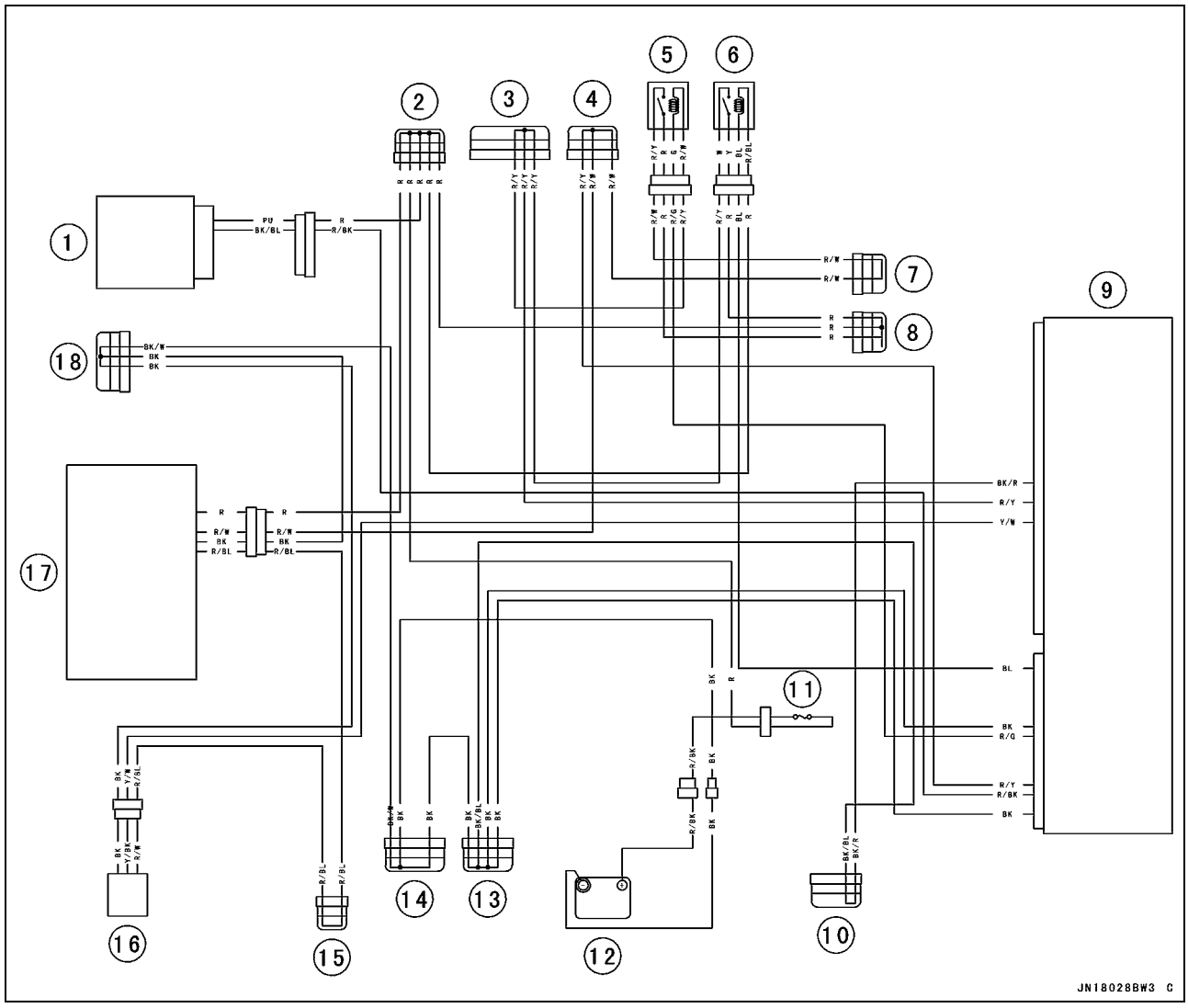
- Remove the ignition key.

★If the reading is out of the standard, check the wiring (see Steering Position Sensor Circuit). Then if the wiring is good, replace the steering position sensor.

★If the reading is the standard, but the Kawasaki Smart Steering system does not operate, inspect the following.
ECU (see ECU Power Supply Inspection in the Fuel System (DFI) chapter)

## Kawasaki Smart Steering (KSS) System

### Kawasaki Smart Steering System Circuit



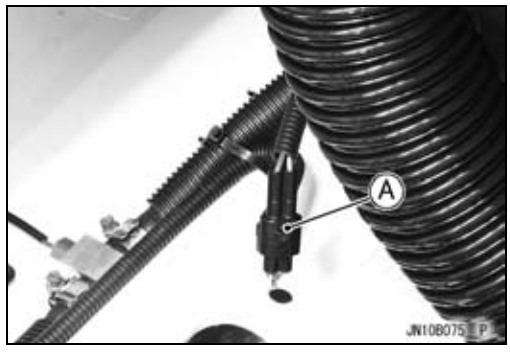

1. Ignition Switch
2. Joint Connector P (12 V)
3. Joint Connector R (12 V)
4. Joint Connector T (12 V)
5. ECU Main Relay
6. System Relay
7. Joint Connector D (12 V)
8. Joint Connector C (12 V)
9. ECU
10. Joint Connector E (Ground)
11. Main Fuse 20 A
12. Battery
13. Joint Connector Y (Ground)
14. Joint Connector S (Ground)
15. Joint Connector W (12 V)
16. Steering Position Sensor
17. Meter Unit
18. Joint Connector Q (Ground)

## Sensors

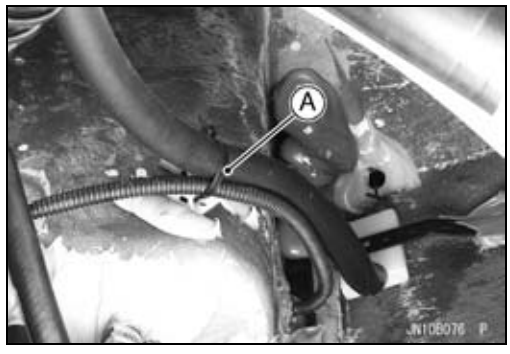
### *Speed Sensor Removal*

- Remove:
  Reboarding Step (see Reboarding Step Removal in the Hull/Engine Hood chapter)
  Reverse Bucket (see Reverse Bucket Removal in the Steering chapter)
  Water Box Muffler (see Water Box Muffler Removal in the Exhaust System chapter)

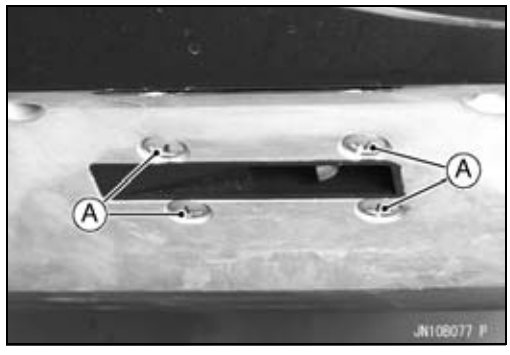
- Disconnect the speed sensor lead connector [A].



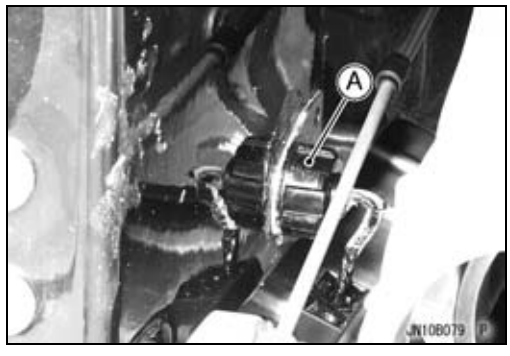

- Remove the band [A].




- Remove the speed sensor mounting screws [A].



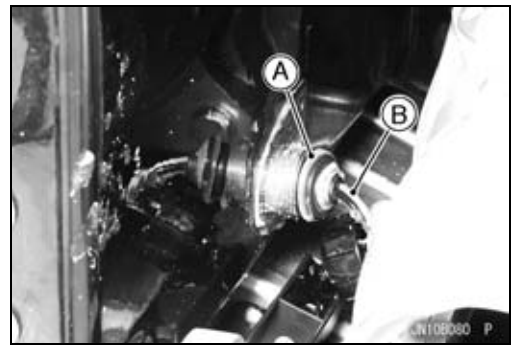

- Remove the cap [A] and take the speed sensor lead off the hull.



## Sensors

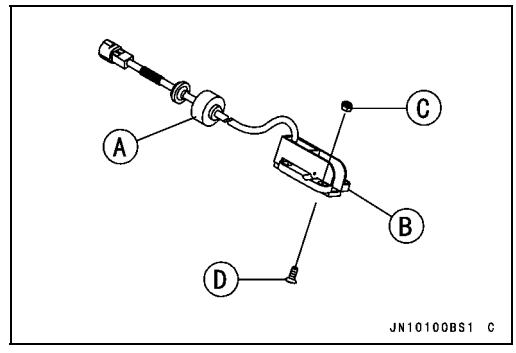
### *Speed Sensor Installation*

- Run the speed sensor lead properly (see Cable, Wire, and Hose Routing section in the Appendix chapter).
- Apply silicone sealant around the grommet [A] and lead wires [B].




- Install:
  Cap [A]
  Speed Sensor [B]
  Nuts [C]
- Apply a non-permanent locking agent to the speed sensor mounting screws [D].
- Tighten:

  **Torque - Speed Sensor Mounting Screws: 3.9 N·m (0.40 kgf·m, 35 in·lb)**

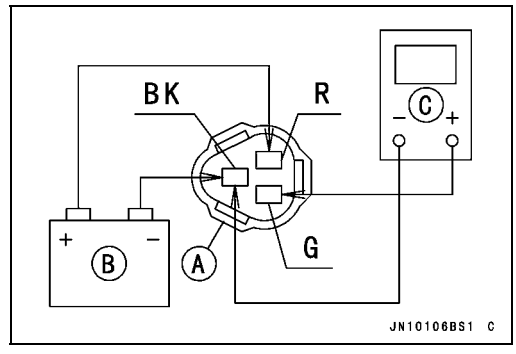



- Install the removed parts (see appropriate chapters).

### *Speed Sensor Inspection*

- Remove the speed sensor (see Speed Sensor Removal).
- Connect the speed sensor lead connector [A] to the battery [B] and the hand tester [C] as shown in the figure.

  **Special Tool - Hand Tester: 57001-1394**
- Set the hand tester to DC 25 V range.

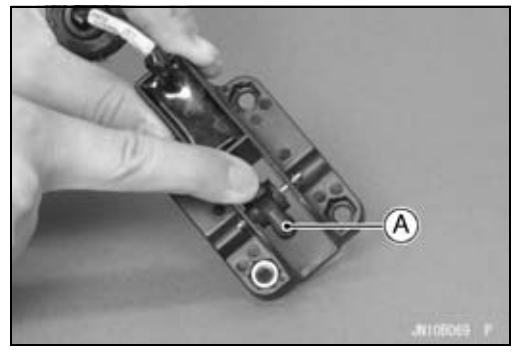



- Measure the speed sensor output voltage in low speed.

○Rotate the waterwheel [A] by hand slowly.

**Output Voltage (in Low Speed)**
**G (+), BK (–) → 0 ~ battery voltage; twice a rotation**

★If the voltage does not rise from zero to battery voltage twice a rotation, replace the speed sensor.

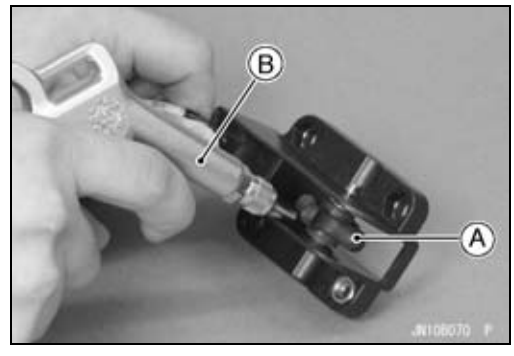



- Measure the speed sensor output voltage in high speed.

○Rotate the waterwheel [A] in a fair speed by compressed air [B].

**Output Voltage (in High Speed)**
**G (+), BK (–) → approx. 5 V**

★If the voltage does not reach 5 volts when spun with compressed air, replace the speed sensor.



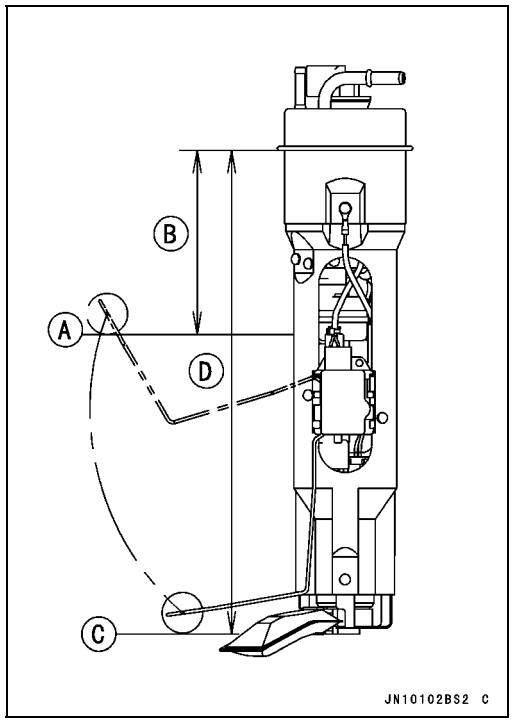
## Sensors

### *Fuel Level Sensor Inspection*

- Remove the fuel pump (see Fuel Pump Removal in the Fuel System (DFI) chapter).
- Check that the float moves smoothly without binding, and it should lower fully by own weight.

★If the float does not move smoothly, replace the sensor.

Float in Full Position [A]
121.5 ±6 mm (4.783 ±0.2 in.) [B]
Float in Empty Position [C]
318.5 ±6 mm (12.54 ±0.2 in.) [D]

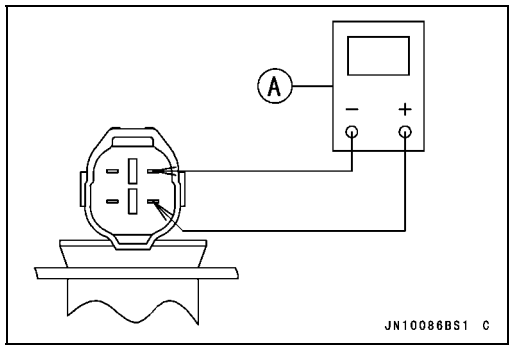



- Using the hand tester [A], measure the resistance across the terminals in the fuel level sensor lead connector.

**Special Tool - Hand Tester: 57001-1394**

**Fuel Level Sensor Resistance**
**Standard: Full position: 2 ~ 4 Ω**
**Empty position: 117 ~ 123 Ω**

★If the tester readings are not as specified, or do not change smoothly according as the float moves up and down, replace the sensor.




### *Water Temperature Sensor Removal/Installation*

- Refer to the Water Temperature Sensor Removal/Installation in the Fuel System (DFI) chapter.

## Sensors

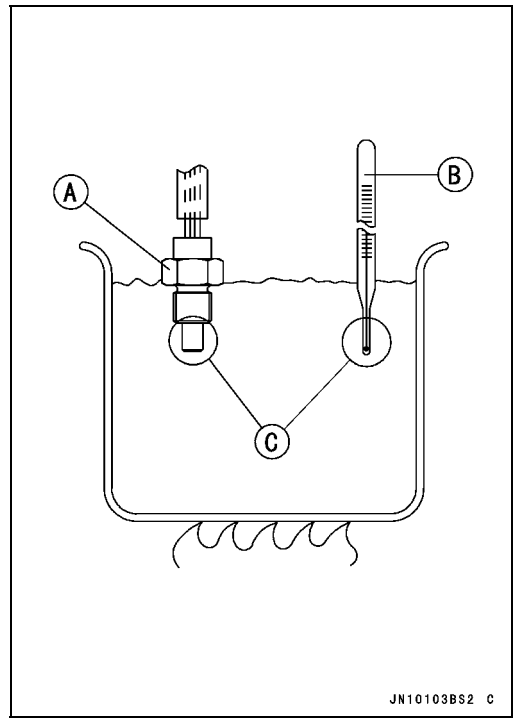
### *Water Temperature Sensor Inspection*

- Remove the water temperature sensor (see Water Temperature Sensor Removal/Installation in the Fuel System (DFI) chapter).
- Suspend the sensor [A] in a container of water so that the threaded portion is submerged.
- Suspend an accurate thermometer [B] with temperature sensing portions [C] located in almost the same depth.

**NOTE**

○*The sensor and thermometer must not touch the container side or bottom.*

- Place the container over a source of heat and gradually raise the temperature of the water while stirring the water gently.




- Measure the internal resistance of the sensor with a digital meter.

○The sensor sends electric signals to the ECU.

○Measure the resistance across the terminals and the body (for the gauge) at the temperatures shown in the table.

**Water Temperature Sensor Resistance**

| Water Temperature | Sensor Resistance |
|---|---|
| 20°C (68°F) | 12.17 ~ 13.92 kΩ |
| 50°C (122°F) | 4.025 ~ 4.810 kΩ |
| 90°C (194°F) | 1.182 ~ 1.481 kΩ |
| 100°C (212°F) | 0.9025 ~ 1.142 kΩ |

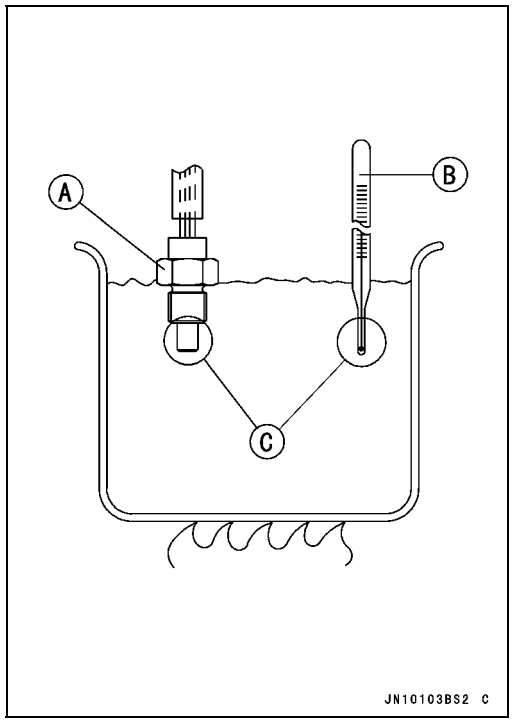
★If the digital meter does not show the specified values, replace the sensor.

### *Oil Temperature Sensor Removal/Installation*

- Refer to the Oil Temperature Sensor Removal/Installation in the Fuel System (DFI) chapter.

## Sensors

### *Oil Temperature Sensor Inspection*




- Remove the oil temperature sensor (see Oil Temperature Sensor Removal/Installation in the Fuel System (DFI) chapter).
- Suspend the sensor [A] in a container of water so that the threaded portion is submerged.
- Suspend an accurate thermometer [B] with temperature sensing portions [C] located in almost the same depth.

**NOTE**

○*The sensor and thermometer must not touch the container side or bottom.*

- Place the container over a source of heat and gradually raise the temperature of the water while stirring the water gently.
- Measure the internal resistance of the sensor with a digital meter.

○The sensor sends electric signals to the ECU.

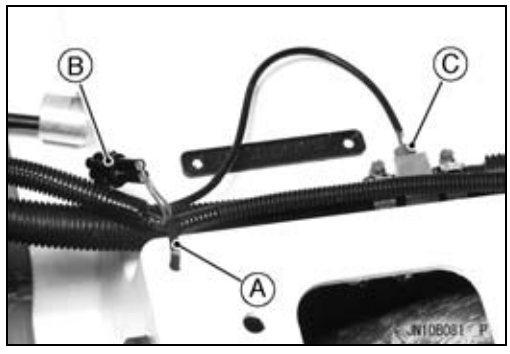
○Measure the resistance across the terminals and the body (for the gauge) at the temperatures shown in the table.

**Oil Temperature Sensor Resistance**

| Oil Temperature | Sensor Resistance |
|---|---|
| 20°C (68°F) | 12.17 ~ 13.92 kΩ |
| 50°C (122°F) | 4.025 ~ 4.810 kΩ |
| 90°C (194°F) | 1.182 ~ 1.481 kΩ |
| 100°C (212°F) | 0.9025 ~ 1.142 kΩ |

★If the digital meter does not show the specified values, replace the sensor.

### *Water Temperature Sensor (for Meter Unit) Removal/Installation*



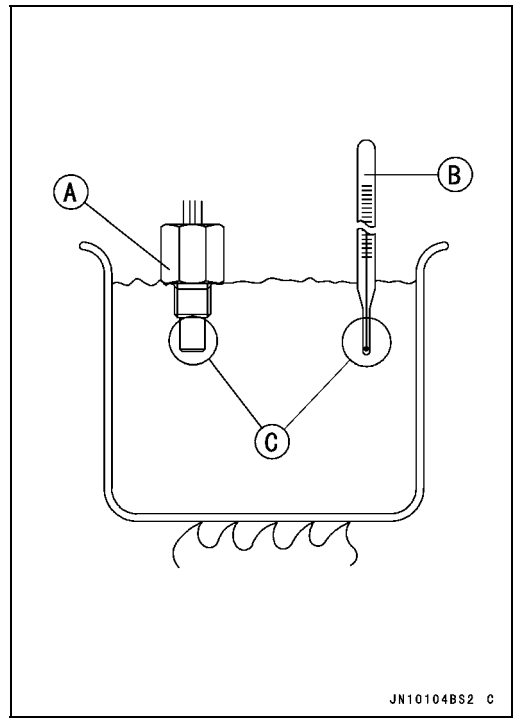

- Remove:
  Air Box (see Air Box Removal in the Fuel System (DFI) chapter)
  Band [A]
  Water Temperature Sensor (for Meter Unit) Lead Connector [B]
  Water Temperature Sensor (for Meter Unit) [C]
- Installation is the reverse of removal. Note the following.

○Tighten:

**Torque - Water Temperature Sensor (for Meter Unit): 8.8 N·m (0.90 kgf·m, 78 in·lb)**

## Sensors

### *Water Temperature Sensor (for Meter Unit) Inspection*




- Remove the water temperature sensor (for meter unit) (see Water Temperature Sensor (for Meter Unit) Removal/Installation).
- Suspend the sensor [A] in a container of water so that the threaded portion is submerged.
- Suspend an accurate thermometer [B] with temperature sensing portions [C] located in almost the same depth.

**NOTE**

○*The sensor and thermometer must not touch the container side or bottom.*

- Place the container over a source of heat and gradually raise the temperature of the water while stirring the water gently.
- Measure the internal resistance of the sensor with a digital meter.

○The sensor sends electric signals to the meter unit.

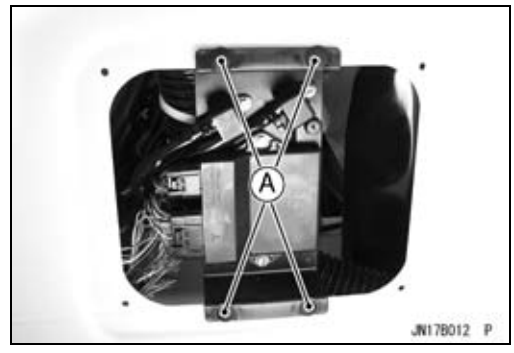
○Measure the resistance across the terminals at the temperatures shown in the table.

**Water Temperature Sensor (for Meter Unit) Resistance**

| Water Temperature | Sensor Resistance |
|---|---|
| 20°C (68°F) | 12.17 ~ 13.92 kΩ |
| 50°C (122°F) | 4.025 ~ 4.810 kΩ |
| 90°C (194°F) | 1.182 ~ 1.481 kΩ |
| 100°C (212°F) | 0.9025 ~ 1.142 kΩ |

★If the digital meter does not show the specified values, replace the sensor.

### *Air Temperature Sensor (for Meter Unit) Removal/Installation*




- Remove:

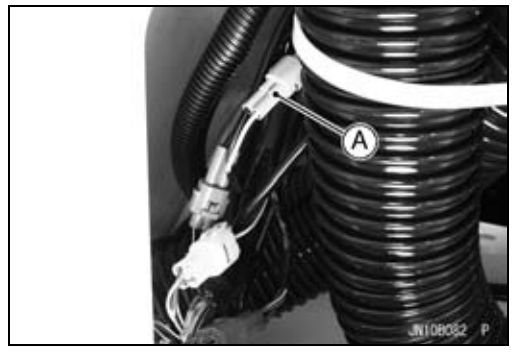
  Front Access Cover (see Front Access Cover Removal in the Hull/Engine Hood chapter)

  Steering Pad (see Steering Removal in the Steering chapter)

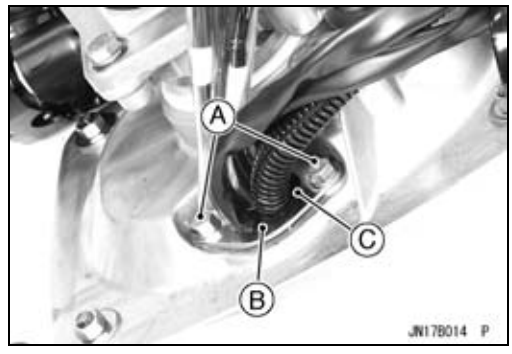
  Rivets [A]

## Sensors

● Disconnect the air temperature sensor (for meter unit) lead connector (Green, 2-pin) [A].




● Remove:
Grommet Holding Plate Bolts [A]
Plate [B]
Grommet [C]
● Take the air temperature sensor (for meter unit) off the tube.




● Installation is the reverse of removal. Note the following.
○Run the sensor properly (see Cable, Wire, and Hose Routing section in the Appendix chapter).
○Apply a non-permanent locking agent to the grommet holding plate bolts.

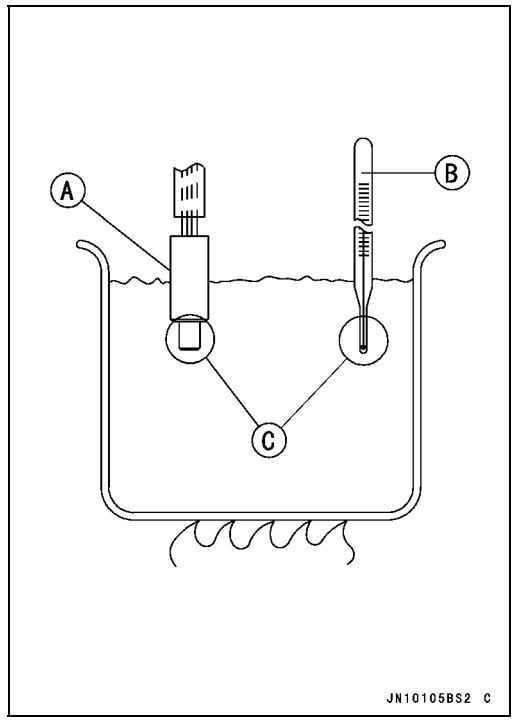
### *Air Temperature Sensor (for Meter Unit) Inspection*

● Remove the air temperature sensor (for meter unit) (see Air Temperature Sensor (for Meter Unit) Removal/Installation).
● Suspend the sensor [A] in a container of machine oil so that the heat-sensitive portion is submerged.
● Suspend an accurate thermometer [B] with heat-sensitive portions [C] located in almost the same depth.

**NOTE**

○*The sensor and thermometer must not touch the container side or bottom.*

● Place the container over a source of heat and gradually raise the temperature of the oil while stirring the oil gently.



## Sensors

● Measure the internal resistance of the sensor with a digital meter.

○The sensor sends electric signals to the meter unit.

○Measure the resistance across the terminals at the temperatures shown in the table.

**Air Temperature Sensor (for Meter Unit) Resistance**

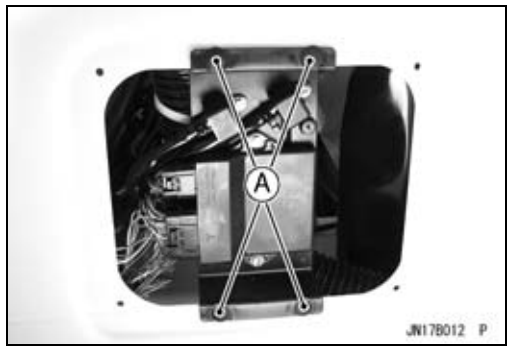
| Oil Temperature | Sensor Resistance |
|---|---|
| 20°C (68°F) | 12.17 ~ 13.92 kΩ |
| 50°C (122°F) | 4.025 ~ 4.810 kΩ |
| 90°C (194°F) | 1.182 ~ 1.481 kΩ |
| 100°C (212°F) | 0.9025 ~ 1.142 kΩ |

★If the digital meter does not show the specified values, replace the sensor.

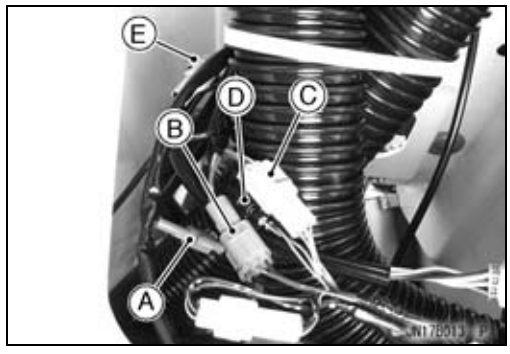
## Multifunction Meter

### *Meter Unit Removal*

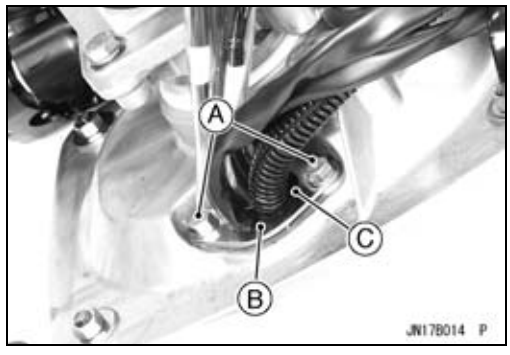
● Remove:
Front Access Cover (see Front Access Cover Removal in the Hull/Engine Hood chapter)
Steering Cover (see Steering Removal in the Steering chapter)
Rivets [A]



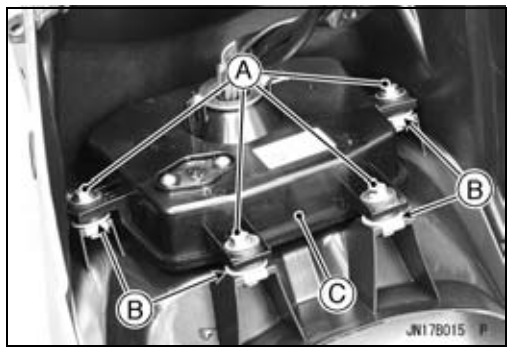

● Disconnect the meter unit lead connectors.
Blue, 2-pin [A]
Blue, 4-pin [B]
Yellow, 4-pin [C]
Black, 2-pin [D]
Green, 2-pin [E]




● Remove:
Nuts [A]
Plate [B]
Grommet [C]




● Remove:
Bolts [A]
Washers and Collars [B]
Meter Unit [C]

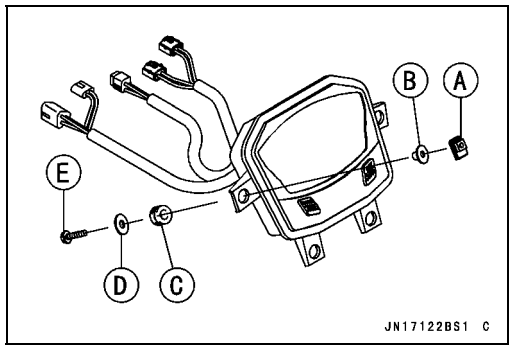



### *Meter Unit Installation*

● Installation is the reverse of removal. Note the following.
○Be sure the nuts [A], collars [B], rubber dampers [C] and the washers [D] are in place.
○Apply a non-permanent locking agent to the meter unit mounting bolts [E].
○Tighten:

**Torque - Meter Unit Mounting Bolts: 9.8 N·m (1.0 kgf·m, 87 in·lb)**

○Run the meter unit leads properly (see Cable, Wire, and Hose Routing section in the Appendix chapter).



## Multifunction Meter

### *Meter Unit Operation Inspection*

***NOTICE***

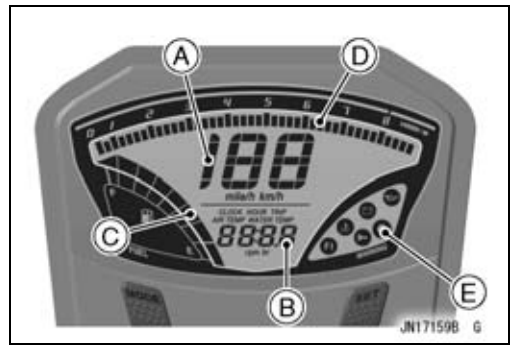
**If the meter unit is left upside down or sideways for a long time or dropped, it will malfunction. Do not drop the meter unit. Place the meter unit so that it faces upward. Do not short each terminal.**

**NOTE**

○*Be sure the battery is fully charged.*
○*Be sure the wiring is normality (see Meter Unit Circuit).*

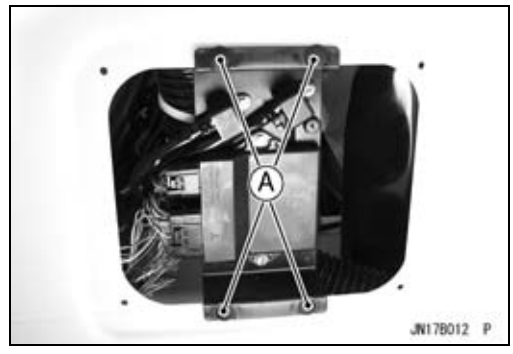
**Check 1-1: Switching Inspection**

● Insert the ignition key in the ignition switch to turn it on and check the following.
○Following LCD segments appear gradually.
Speedometer [A]
Multifunction Meter [B]
Fuel Level Gauge [C]
Tachometer [D]
○The red warning indicator light (LED) [E] goes on.
○The buzzer sounds twice.

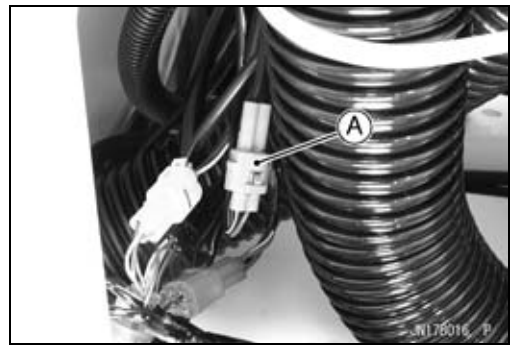



★If the LCD segments do not work, replace the meter unit.
★If the red warining indicator light (LED) does not go on, replace the meter unit.
★If the buzzer does not work, inspect the buzzer.

● Remove:
Front Access Cover (see Front Access Cover Removal in the Hull/Engine Hood chapter)
Rivets [A]




● Disconnect the buzzer connector (blue, 2-pin) [A].



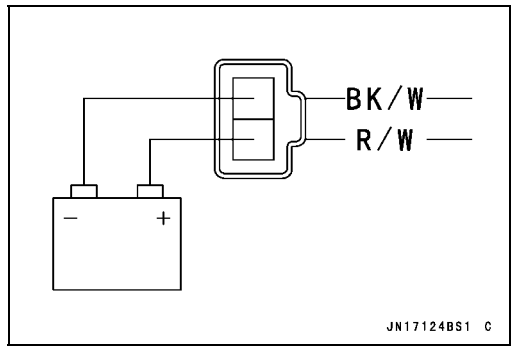
## Multifunction Meter

● Connect the battery to the buzzer lead as shown in the figure.

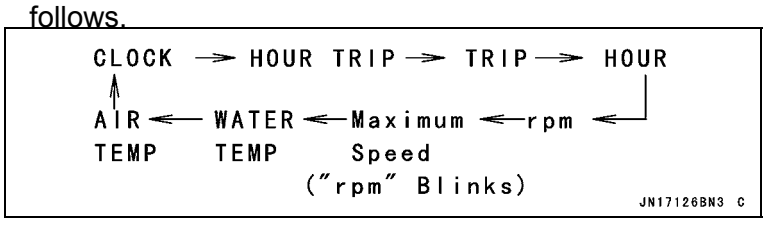
**Connections:**

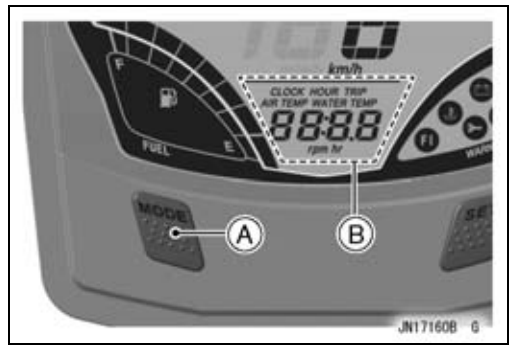
| | | |
|---|---|---|
| **Battery (+)** | ←→ | **R/W lead** |
| **Battery (–)** | ←→ | **BK/W lead** |

★If the buzzer does not work, replace the buzzer.




● By pushing the MODE button [A] less than a second each time, check that the multifunction display [B] changes as follows.




### NOTE

○*These modes will shift in series when the MODE button pushed for 2 seconds or more.*

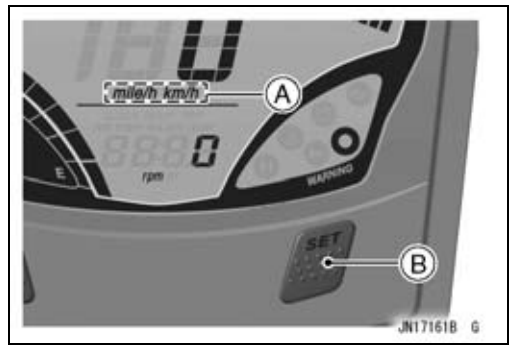
○*When the multifunction meter displays a warning, push the MODE or SET button for 1 second to return to the normal display.*

○*The MODE button operates when the engine is running slower than 3 000 r/min (rpm).*

★If the display function does not work, replace the meter unit.

● In the Hour mode, check that the Mile/Km display [A] switches to the “km/h” or “mile/h” by pushing the SET button [B] for more than 3 seconds.

○The Mile/Km display starts blinking, and the multifunction meter disappears.




### NOTE

○*Mile/Km Display can alternate between English and metric modes (mile and km) in the digital meter. Make sure that km or mile according to local regulations is correctly displayed before riding.*

★If the display function does not work, replace the meter unit.

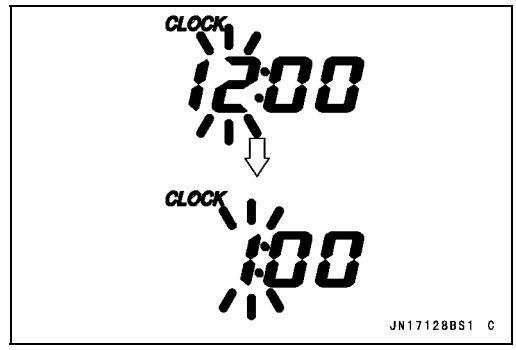
## Multifunction Meter

**Check 1-2: Clock Setting Inspection**

- In the Clock mode, check that the clock display switches to the Hour-setting mode by pushing the SET button for 2 seconds or more.

○The hour display starts blinking when the mode switches.

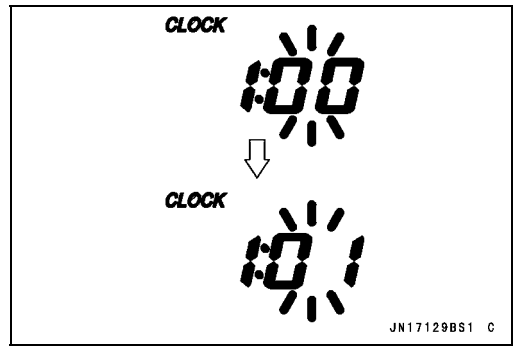
- Check that the hour display changes by pushing the MODE button.




- In the Hour-setting mode, check that the clock display switches to the Minute-setting mode by pushing the SET button.

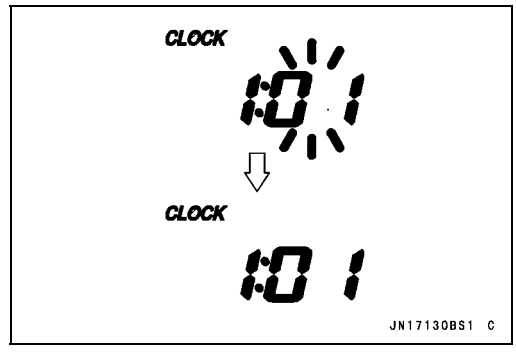
○The minute display starts blinking.

- Check that the minute display changes by pushing the MODE button.



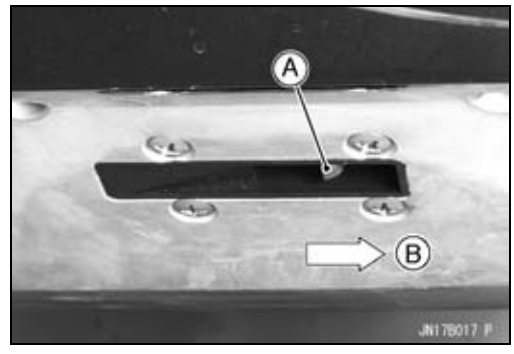

- In the Minute-setting mode, check that the clock setting process completes by pushing the SET button.

★If the display function does not work, replace the meter unit.




**Check 1-3: Maximum Speed/Engine RPM Display Inspection**

- Insert the ignition key in the ignition switch to turn it on.
- Rotate the water wheel [A] by hand or compressed air.
  Rotatory Direction [B]

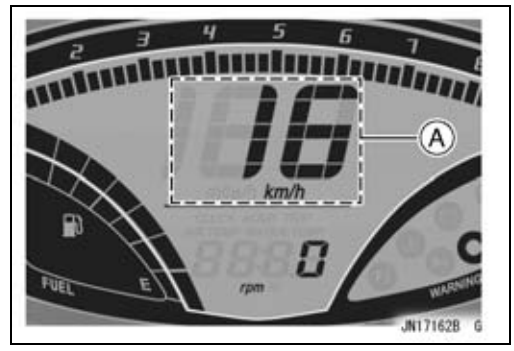



- In the Maximum Speed/Engine RPM mode, check that the speedometer [A] shows maximum speed.

○First, the display shows “0 km/h or 0 mile/h” and “0 rpm”.

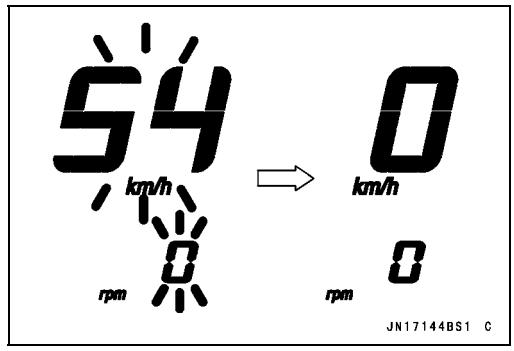
★If the display function does not work, inspect the speed sensor (see Speed Sensor Inspection).

★If the speed sensor is good, check the speed sensor power supply (see Check 2-3).

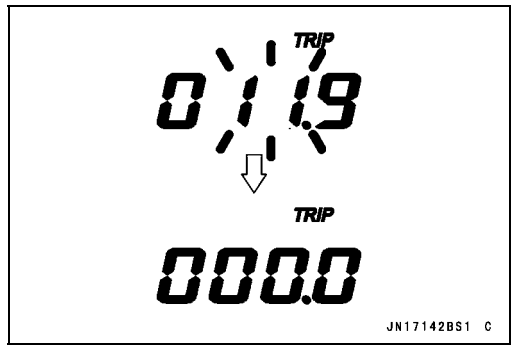


## Multifunction Meter

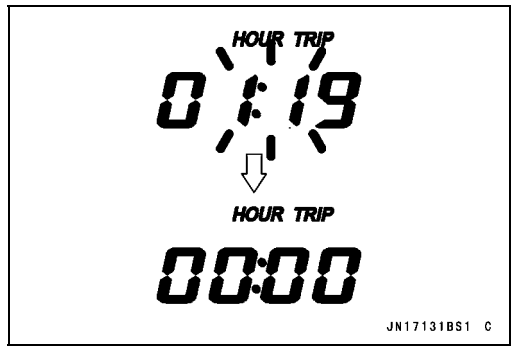
● Check that the display turns to “0” by pushing the SET button for 2 seconds or more.
○The speedometer and engine speed display starts blinking.
★If the display function does not work, replace the meter unit.



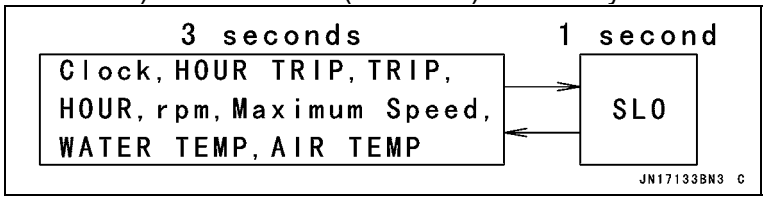

**Check 1-4: Trip Meter Inspection**
● In the Trip Meter mode, check it by the same way as Check 1-3.
★If the display function does not work, replace the meter unit.
● Check that the display turns to “000.0” by pushing the SET button for 2 seconds or more.
○The Trip Meter blinks until the display is reset.
★If the display function does not work, replace the meter unit.

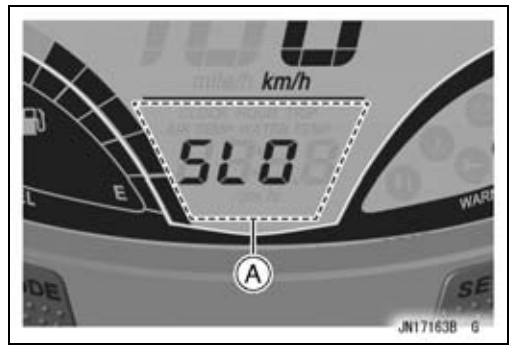



**Check 1-5: Time Meter Inspection**
● In the Time Meter mode, check that the display turns to “00:00” by pushing the SET button for 2 seconds or more.
○The Time Meter blinks until the display is reset.
★If the display function does not work, replace the meter unit.




**Check 1-6: SLO (Smart Learning Operation) Mode Display Inspection**
● Using the SLO key (yellow-colored and marked SLO), insert the ignition key in the ignition switch to turn it on.
● Check that the display [A] switch to the normal display (3 seconds) and the “SLO” (1 second) alternately as follows.




**NOTE**
○*Under the SLO mode, all the meter displays and other functions work in the same manner as the FPO (Full Power Operation) mode.*

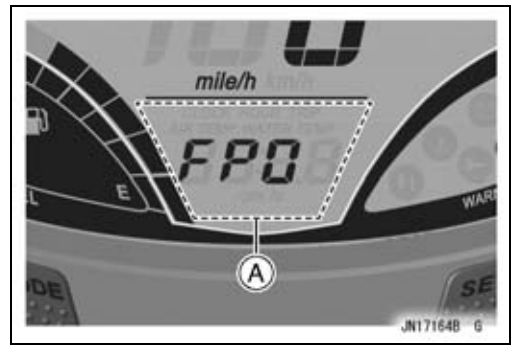
★If the display function does not work, replace the meter unit.

## Multifunction Meter

**Check 1-7: FPO (Full Power Operation) Mode Display Inspection**

- Using the FPO key (orange-colored), insert the ignition key in the ignition switch to turn it on.
- Check that the "FPO" appears in the display [A] for 2 seconds before the normal display appears.

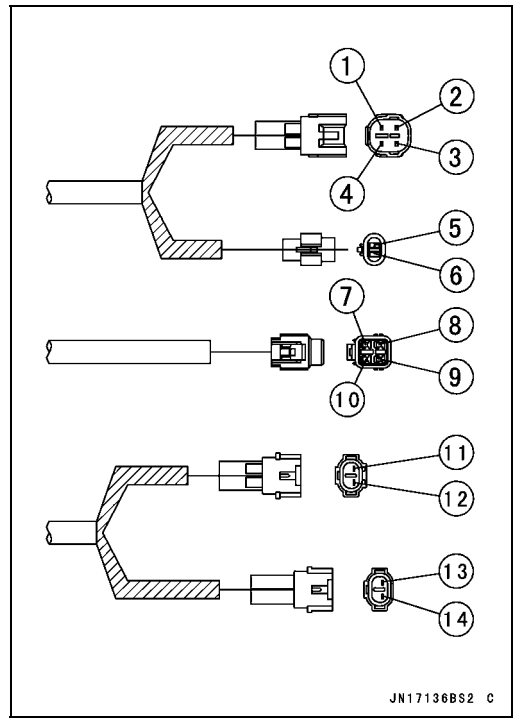
★If the display function does not work, replace the meter unit.




### *Meter Unit Inspection*

- Remove the meter unit (see Meter Unit Removal).

[1] Battery (+): R
[2] Ground (–): BK
[3] Speed Sensor/Steering Position Sensor (+): R/BL
[4] Ignition Switch (+): R/W
[5] Buzzer (–): BK/W
[6] Buzzer (+): R/BK
[7] Fuel Level Sensor: W/R
[8] ECU communication Signal: BL/BK
[9] Unused
[10] Speed Sensor Signal: G/R
[11] Water Temperature Sensor (+): BR
[12] Water Temperature Sensor (–): BK/BR
[13] Air Temperature Sensor (+): LG
[14] Air Temperature Sensor (–): BK/R




***NOTICE***

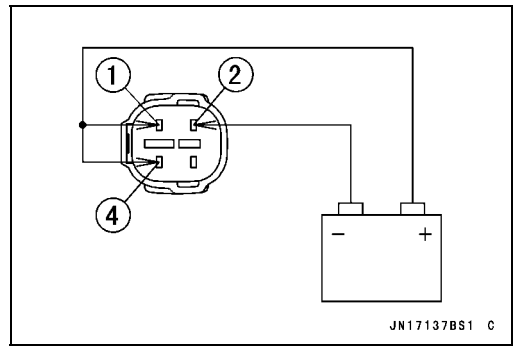
**Do not drop the meter unit. Place the meter unit so that it faces upward. If the meter unit is left upside down or sideways for a long time or dropped, it will malfunction. Do not short each terminal.**

**Check 2-1: Meter Unit Power Supply Inspection**

- Using auxiliary leads, connect the 12 V battery to the meter unit connector as follows.

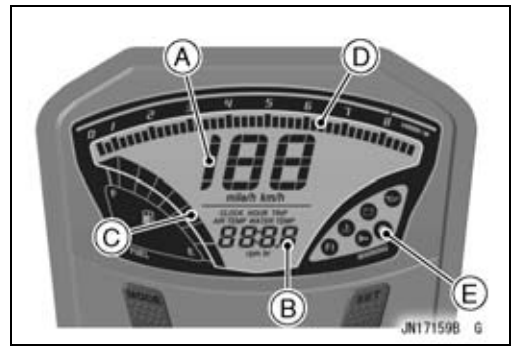
○Connect the battery (+) terminal to the terminal [1].
○Connect the battery (–) terminal to the terminal [2].

- Connect the terminal [4] to the battery (+) terminal.



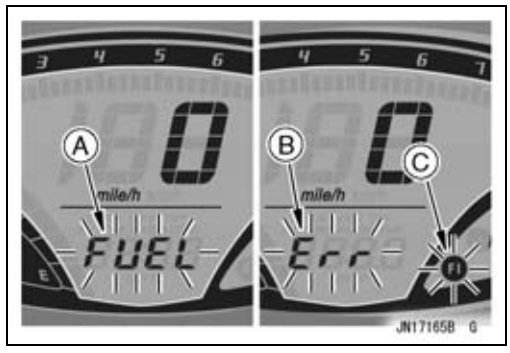

- Check the following items.

○Following LCD segments appear gradually.
Speedometer [A]
Multifunction Meter [B]
Fuel Level Gauge [C]
Tachometer [D]
○The red warning indicator light (LED) [E] goes on.

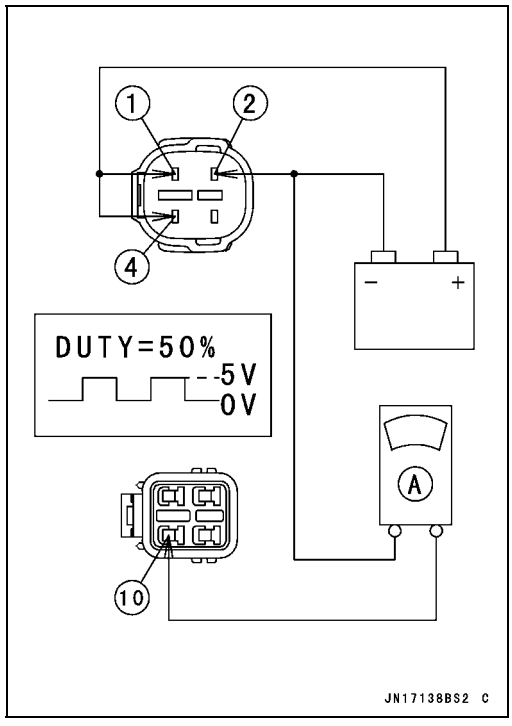


## Multifunction Meter

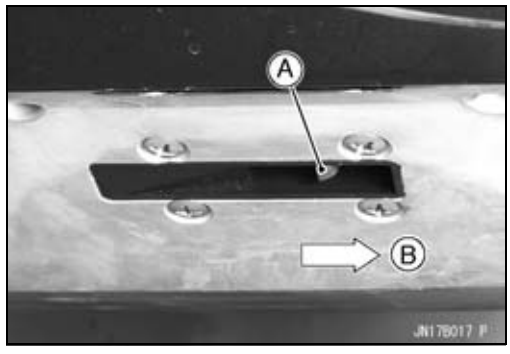
○The “FUEL” [A] blinks for 5 seconds, and then the “Err” [B] and the FI warning symbol [C] start blinking.
○Push the MODE or SET button for 1 second, the multi-function meter switches to the normal display.
★If the meter does not work, replace the meter unit.



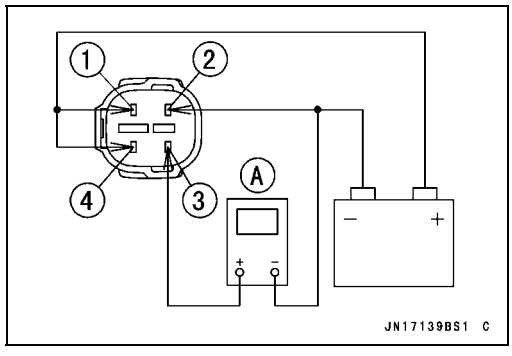

**Check 2-2: Speedometer Inspection**
● Connect the meter unit leads to the battery in the same circuit as Check 2-1.
● Connect an oscillator [A] to the terminal [10] and the ground.
○The speedometer displays the speed that rests on the frequency when the square wave is input.
○The speedometer indicates approximately 40 mph (64 km/h) when the input frequency is approximately 214 Hz.
★If the display function does not work, replace the meter unit.




★If the oscillator is not available, the speedometer can be checked as follows.
○Install the meter unit (see Meter Unit Installation).
○Insert the ignition key in the ignition switch to turn it on.
○Rotate the water wheel [A] by hand.
Rotatory Direction [B]
○Check that the speedometer shows the speed.
★If the display function does not work, inspect the speed sensor (see Speed Sensor Inspection).
★If the speed sensor is good, check the speed sensor power supply (see Check 2-3).



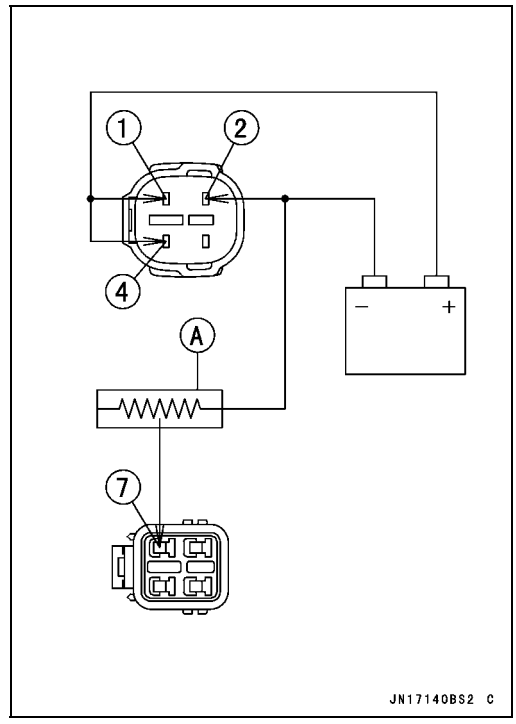

**Check 2-3: Speed Sensor Power Supply Inspection**
● Connect the meter unit leads to the battery in the same circuit as Check 2-1.
● Set the hand tester [A] to the DC 25 V range and connect it to the meter unit as follows.
**Special Tool - Hand Tester: 57001-1394**
○Connect the tester (+) terminal to the terminal [3].
○Connect the tester (–) terminal to the terminal [2].
★If the power supply voltage shows a much lower than 10.8 V, replace the meter unit.



## Multifunction Meter

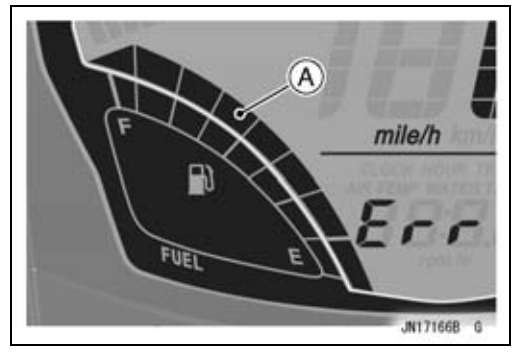
**Check 2-4: Fuel Level Gauge Inspection**

- Connect the meter unit leads to the battery in the same circuit as Check 2-1.
- Connect the variable rheostat [A] to the terminal [7] and the battery (-) terminal.




- Check that the segments number of the fuel level gauge [A] matches the resistance value of the variable rheostat.

| Variable Rheostat Resistance (Ω) | Fuel Level Gauge |
|---|---|
| 5 | 8 Segments Appear |
| 60 | 1 Segment Blinks |
| 100 | All Segments Disappear |

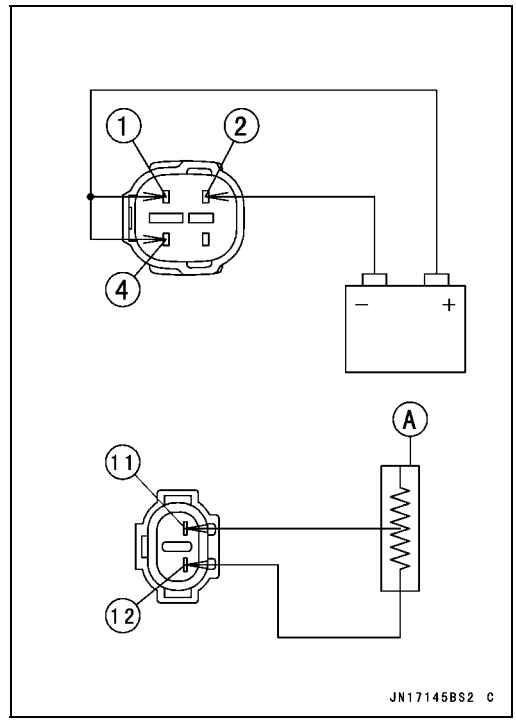



○The fuel level gauge is updated every 10 seconds.

★If the display function does not work, replace the meter unit.

**Check 2-5: Water Temperature Meter Inspection**

- Connect the meter unit leads to the battery in the same circuit as Check 2-1.
- Connect the variable rheostat [A] to the terminal [11] and the terminal [12].

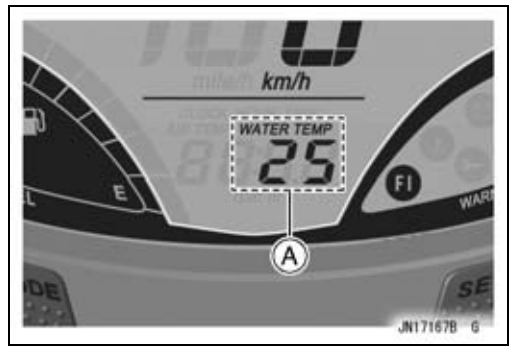


## Multifunction Meter

- Check that the water temperature meter [A] matches the resistance value of the variable rheostat.

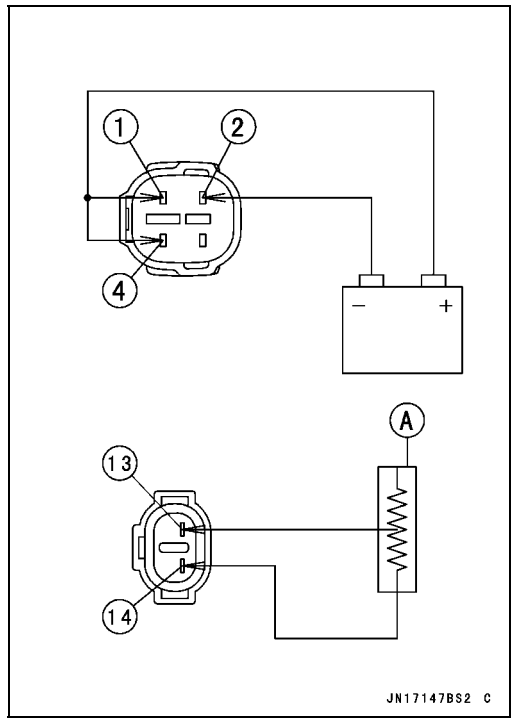
| Variable Rheostat Resistance (kΩ) | Water Temperature Meter |
|---|---|
| 30.00 | About 0°C (32°F) |
| 10.74 | About 25°C (77°F) |

★If the display function does not work, replace the meter unit.




**Check 2-6: Air Temperature Meter Inspection**

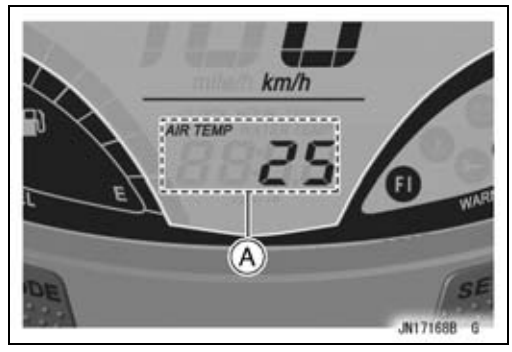
- Connect the meter unit leads to the battery in the same circuit as Check 2-1.
- Connect the variable rheostat [A] to the terminal [13] and the terminal [14].




- Check that the air temperature meter [A] matches the resistance value of the variable rheostat.

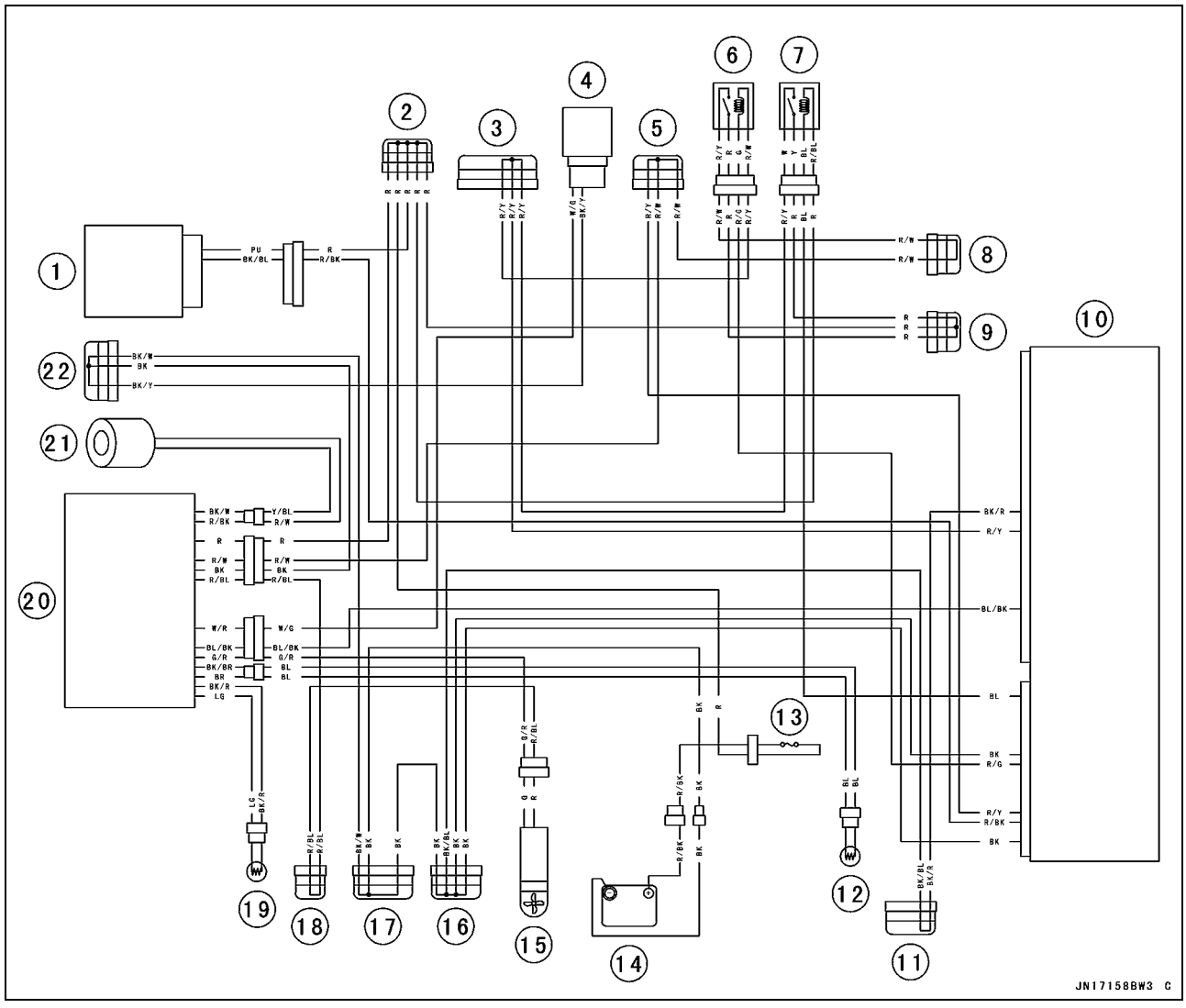
| Variable Rheostat Resistance (kΩ) | Air Temperature Meter |
|---|---|
| 30.00 | About 0°C (32°F) |
| 10.74 | About 25°C (77°F) |

★If the display function does not work, replace the meter unit.



## Multifunction Meter

### Multifunction Meter Circuit




1. Ignition Switch
2. Joint Connector P (12 V)
3. Joint Connector R (12 V)
4. Fuel Level Sensor (Fuel Pump)
5. Joint Connector T (12 V)
6. ECU Main Relay
7. System Relay
8. Joint Connector D (12 V)
9. Joint Connector C (12 V)
10. ECU
11. Joint Connector E (Ground)
12. Water Temperature Sensor (for Meter Unit)
13. Main Fuse 20 A
14. Battery
15. Speed Sensor
16. Joint Connector Y (Ground)
17. Joint Connector S (Ground)
18. Joint Connector W (12 V)
19. Air Temperature Sensor (for Meter Unit)
20. Meter Unit
21. Buzzer
22. Joint Connector Q (Ground)

## Immobilizer System

This watercraft is equipped with an immobilizer system to protect the watercraft from theft. This system provides a theft proof device by means of matching a code between the inbuilt key transponder and ECU (Electronic Control Unit). If the code does not match, ignition system, injectors and fuel pump will not operate and the engine will not start.

**Abstract**

- If the red warning indicator light (LED), immobilizer warning symbol and the following character blink on the meter unit, and the buzzer sound goes off after the key is pressed, this shows a fault in the immobilizer system.
  Imb-Immobilizer Amplifier Failure (Service Code: 35)
  IgnI-Not Matching Key Code (Service Code: 36)

○Refer to the service code or character to identity the faulty component.

- If all coded keys (FPO key: orange-colored and SLO key: yellow-colored and marked SLO) are lost, the ECU will have to be replaced.
- The immobilizer system can not function until the user key code is registered in the ECU.
- A total of six keys can be registered in the ECU at any one time.

***Operational Cautions***

1. Do not expose the keys to excessively high temperature.
2. Do not place keys close to magnets.
3. Do not place a heavy item on any key.
4. Do not damage the plastic covers.
5. Do not give shocks to the keys.
6. One registered key is needed to have a new key (or keys) registered to ECU.
7. If both registered keys have been lost, renew the ECU.

**NOTE**

○*Since the immobilizer system uses the electric wave for communication, key identification error may occur where other electric waves abound.*

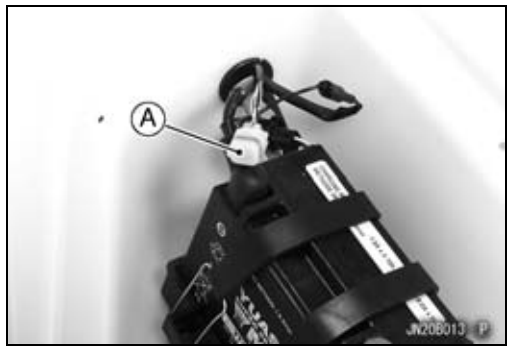
***Key Registration***

**Case 1: When the user key has been lost or additional spare user key is required.**

**NOTE**

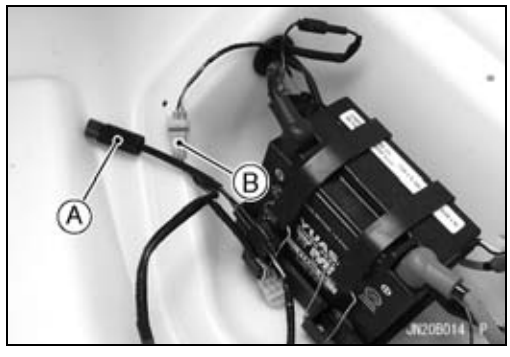
○*Be sure the battery is fully charged.*

- Prepare a new spare user key.
- Remove the battery cover (see Battery Cover Removal/Installation).
- Disconnect the immobilizer/Kawasaki diagnostic system connector [A].




- Connect the key registration unit [A].

**Special Tools - Key Registration Unit: 57001-1582**
**Key Registration Adapter: 57001-1746 [B]**




**Pre-registration of User Key 1**

**NOTE**

○*Keep the other user key away from the ignition switch.*

- Insert the registered key (user key 1) to the ignition switch and press it for a short time (within 2 seconds).

## Immobilizer System

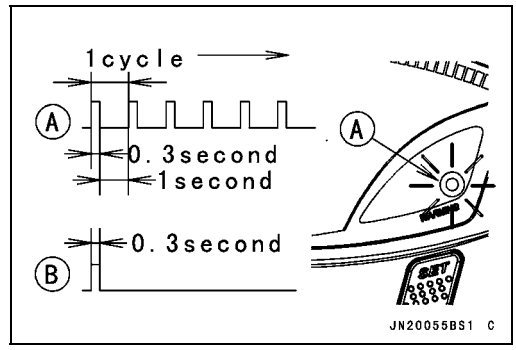
**Verified**

○The ECU confirms the following.
Receiving signals from immobilizer amplifier are correct.
The inserted key is the registered one.

○All user key codes in ECU are eliminated.

● The user key 1 is successfully pre-registered in the ECU, and ECU starts the key registration mode.

○The red warning indicator light (LED) [A] blinks 1 time and stops for 1 second and then repeats this cycle.



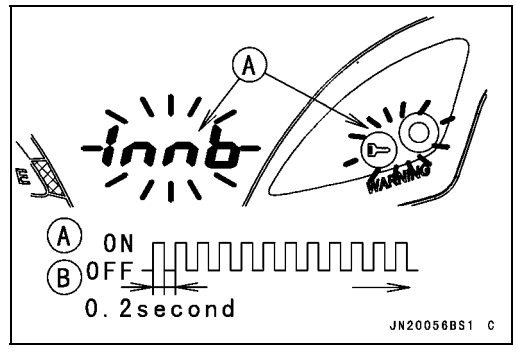

**NOTE**

○*Only the first one cycle, the buzzer sound [B] goes off synchronizing with the blink of red warning indicator light (LED).*

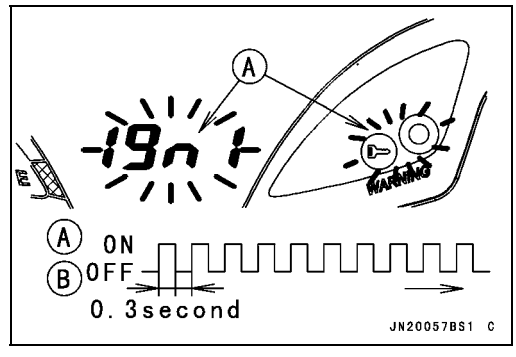
**Not Verified**

○The red warning indicator light (LED), immobilizer symbol and letters [A] blink to display the collation error. The buzzer sound [B] goes off. (refer to the following failure illustrations).

Immobilizer Amplifier Failure (Service Code/Character -35/Imb)




Key Collation Error (Service Code/Character-36/IgnI)




**Pre-registration of User Key n (2 ~ 6)**

● Remove the user key 1.

● Insert the unregistered key (user key 2) and press it for a short time (within 2 seconds).

**NOTE**

○*Continue with the procedure to register the second and later keys before the 15 seconds period has elapsed, the registration mode automatically finishes and the red warning indicator light (LED) will switch off.*

○*At this procedure, the unregistered key (user key 2) is pressed for a long time (2 seconds or more), the procedure goes to the regular registration of user key (see Regular Registration of User Key).*

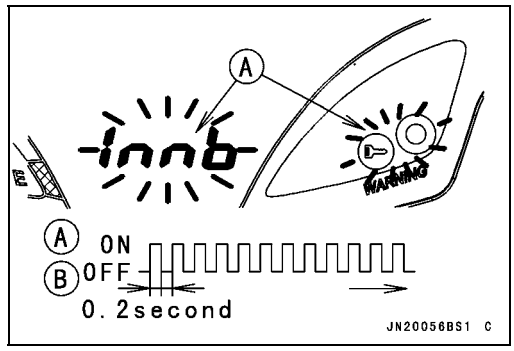
○The ECU confirms the following.
Receiving signals from immobilizer amplifier are correct.
The inserted key is the unregistered one.
The number of the registered key is six or less.

## Immobilizer System

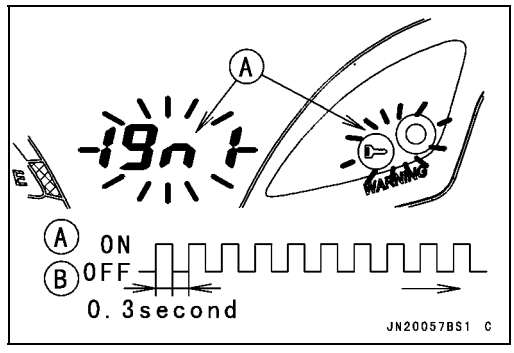
**Not Verified**

○The red warning indicator light (LED), immobilizer symbol and letters [A] blink to display the collation error. The buzzer sound [B] goes off. (refer to the following failure illustrations).

Immobilizer Amplifier Failure (Service Code/Character -35/Imb)




Key Collation Error (Service Code/Character-36/Ignl)

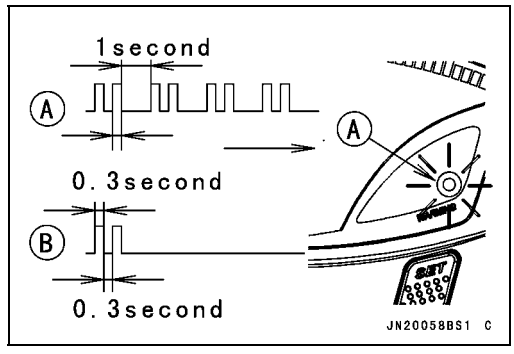



● The user key 2 is successfully pre-registered in the ECU.

○The red warning indicator light (LED) [A] blinks 2 times and stops for 1 second and then repeats this cycle.

**NOTE**

○*Only the first one cycle, the buzzer sounds [B] goes off synchronizing with the blink of the red warning indicator light (LED).*




● Continue the procedures to register additional 4 user keys.

**NOTE**

○*The ECU can store up the six key codes (FPO key × n and SLO key × n).*

**Red Warning Indicator Light (LED) Blink and Buzzer Sound**

| | Red Warning Indicator Light (LED) Blinks and Buzzer Sound | Red Warning Indicator Light (LED) Blinks and Buzzer Sound Stop | Remarks |
|---|---|---|---|
| **User Key 3** | 3 times | 1 second | Repeat |
| **User Key 4** | 4 times | 1 second | Repeat |
| **User Key 5** | 5 times | 1 second | Repeat |
| **User Key 6** | 6 times | 1 second | Repeat |

**NOTE**

○*Only the first cycle, the buzzer sound goes off synchronizing with the blink of red warning indicator light (LED).*

## Immobilizer System

**Regular Registration of User Key**

- Leave the user key (1 ~ 6) in the ignition switch.
- Press key for a long time (2 seconds or more).

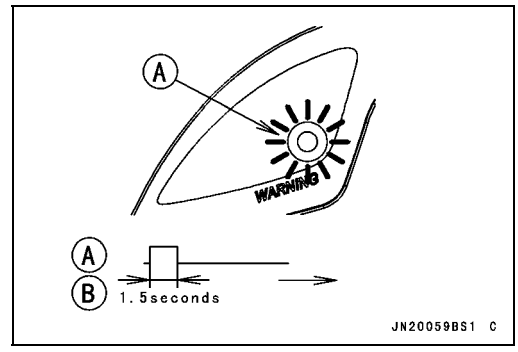
○The ECU confirms the following.
Receiving signals from immobilizer amplifier are correct.
The inserted key is the pre-registered one lastly.

**NOTE**

○*If the inserted key is not the pre-registered one lastly, the key registration mode will end instantaneously. Start the procedure again, pre-registration of user key 1.*

- The pre-registered keys are registered regularly in the ECU.

○The red warning indicator light (LED) [A] blinks 1 time for 1.5 seconds and the buzzer sound [B] goes off 1 time synchronizing with the blink of the red warning indicator light (LED).



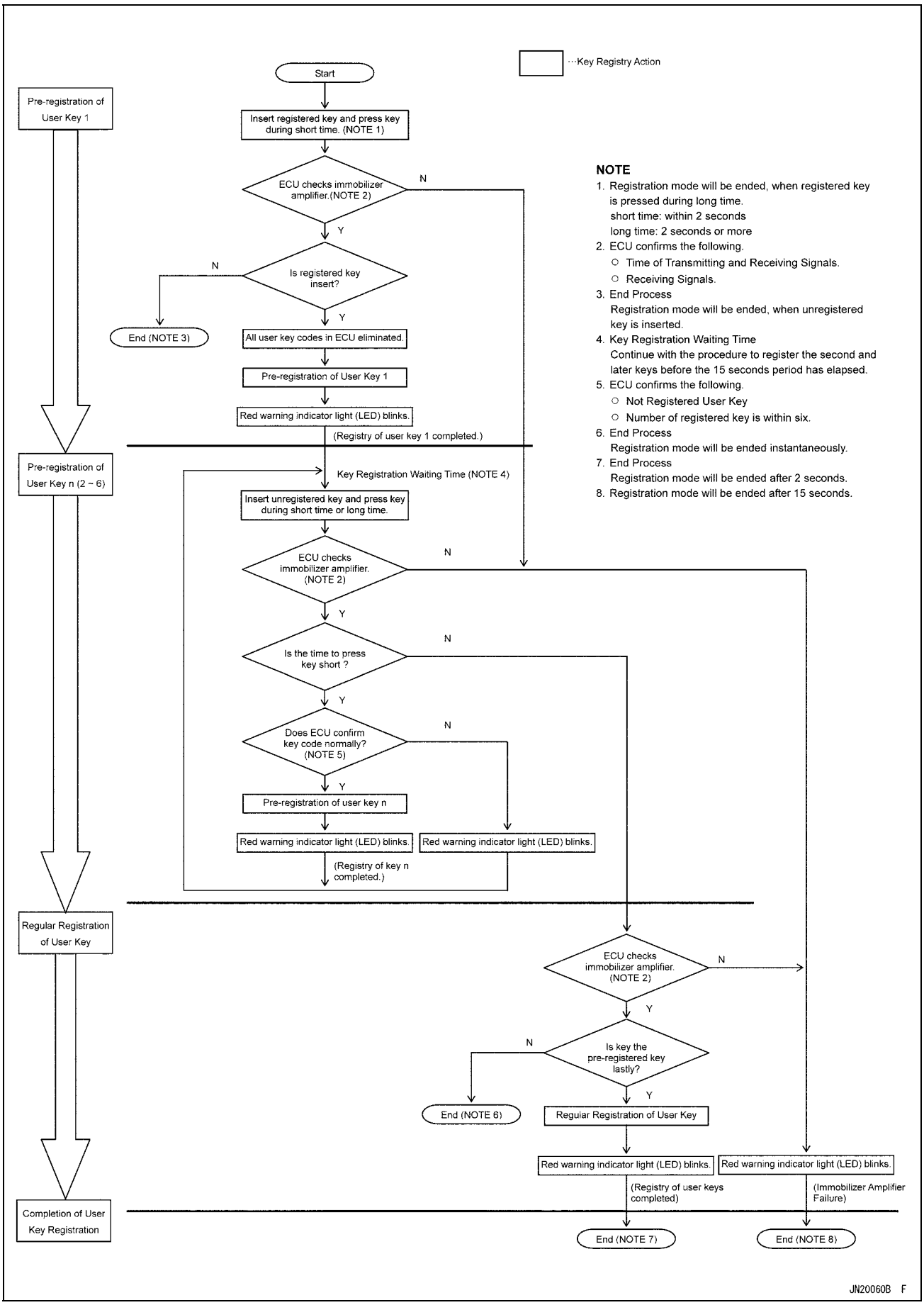

- The key registration mode automatically ends.
- Remove the key registration unit and connect the immobilizer/Kawasaki diagnostic system connector.

**NOTE**

○*Check that the engine can be started using all registered user keys.*

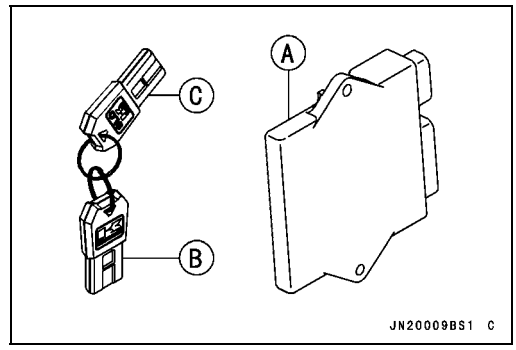
## Immobilizer System

### Spare User Key Registration Flow Chart


···Key Registry Action
Start
Pre-registration of User Key 1
Insert registered key and press key during short time. (NOTE 1)
ECU checks immobilizer amplifier.(NOTE 2)
N
Y
Is registered key insert?
N
Y
End (NOTE 3)
All user key codes in ECU eliminated.
Pre-registration of User Key 1
Red warning indicator light (LED) blinks.
(Registry of user key 1 completed.)
Pre-registration of User Key n (2 ~ 6)
Key Registration Waiting Time (NOTE 4)
Insert unregistered key and press key during short time or long time.
ECU checks immobilizer amplifier. (NOTE 2)
N
Y
Is the time to press key short ?
N
Y
Does ECU confirm key code normally? (NOTE 5)
N
Y
Pre-registration of user key n
Red warning indicator light (LED) blinks.
Red warning indicator light (LED) blinks.
(Registry of key n completed.)
Regular Registration of User Key
ECU checks immobilizer amplifier. (NOTE 2)
N
Y
Is key the pre-registered key lastly?
N
Y
End (NOTE 6)
Regular Registration of User Key
Red warning indicator light (LED) blinks.
Red warning indicator light (LED) blinks.
(Registry of user keys completed)
(Immobilizer Amplifier Failure)
Completion of User Key Registration
End (NOTE 7)
End (NOTE 8)
NOTE
1. Registration mode will be ended, when registered key is pressed during long time.
short time: within 2 seconds
long time: 2 seconds or more
2. ECU confirms the following.
○ Time of Transmitting and Receiving Signals.
○ Receiving Signals.
3. End Process
Registration mode will be ended, when unregistered key is inserted.
4. Key Registration Waiting Time
Continue with the procedure to register the second and later keys before the 15 seconds period has elapsed.
5. ECU confirms the following.
○ Not Registered User Key
○ Number of registered key is within six.
6. End Process
Registration mode will be ended instantaneously.
7. End Process
Registration mode will be ended after 2 seconds.
8. Registration mode will be ended after 15 seconds.
JN20060B F

## Immobilizer System

**Case 2: When the ECU is faulty and has to be replaced.**




**NOTE**

○*Be sure the battery is fully charged.*
○*The key registration unit is not required.*

- Prepare the following.
  New ECU [A]
  Current FPO Key [B] (orange-colored)
  Current SLO Key [C] (yellow-colored and marked SLO)
- Replace:
  ECU (see ECU Removal and Installation in the Fuel System (DFI) chapter)

**Pre-registration of User Key 1**

**NOTE**

○*Keep the other user key away from the ignition switch.*

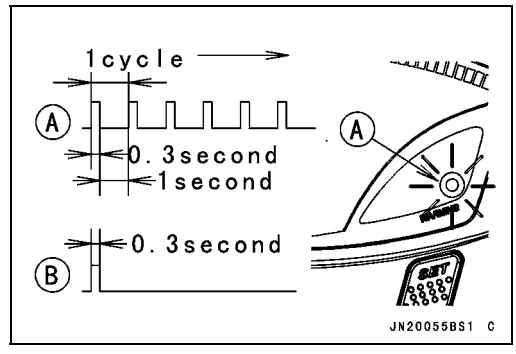
- Insert the current key (user key 1) to the ignition switch and press it for a short time (within 2 seconds) or long time (2 seconds or more).

**Verified**

○The ECU confirms the following.
Receiving signals from immobilizer amplifier are correct.

- The user key 1 is successfully pre-registered in the ECU, and ECU starts the key registration mode.

○The red warning indicator light (LED) [A] blinks 1 time and stops for 1 second and then repeats this cycle.

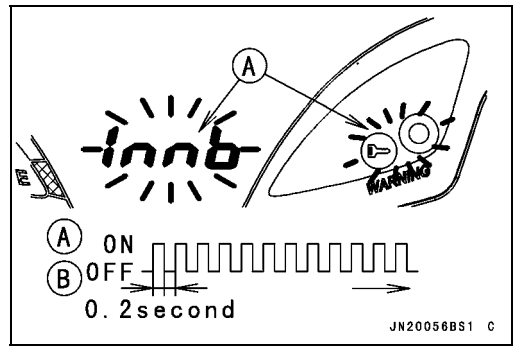



**NOTE**

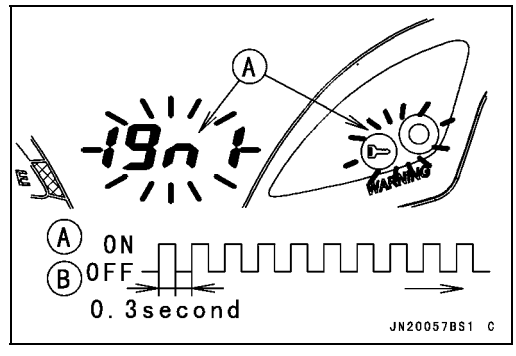
○*Only the first one cycle, the buzzer sound [B] goes off synchronizing with the blink of the red warning indicator light (LED).*

**Not Verified**

○The red warning indicator light (LED), immobilizer symbol and letters [A] blink to display the collation error. The buzzer sound [B] goes off. (refer to the following failure illustrations).
Immobilizer Amplifier Failure (Service Code/Character -35/Imb)




Key Collation Error (Service Code/Character-36/IgnI)



## Immobilizer System

**Pre-registration of User Key 2**

- Remove the user key 1.
- Insert the user key 2 and press it for a short time (within 2 seconds) or long time (2 seconds or more).

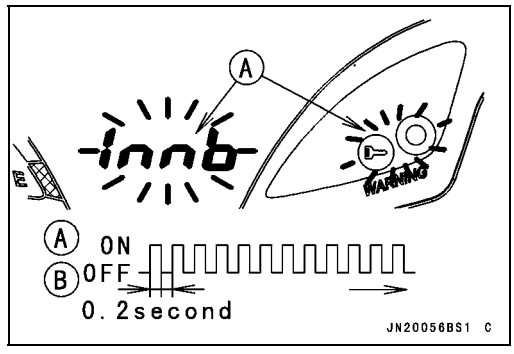
**NOTE**

○*Continue with the procedure to register the first and second keys before the 15 seconds period has elapsed the registration mode automatically finishes and the red warning indicator light (LED) will switch off.*

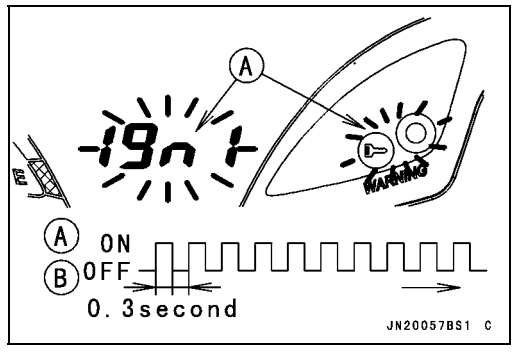
○The ECU confirms the following.
Receiving signals from immobilizer amplifier are correct.
The inserted key is the unregistered one.

**Not Verified**

○The red warning indicator light (LED), immobilizer symbol and letters [A] blinks to display the collation error. The buzzer sound [B] goes off. (refer to the following failure illustrations).
Immobilizer Amplifier Failure (Service Code/Character -35/Imb)




Key Collation Error (Service Code/Character-36/IgnI)

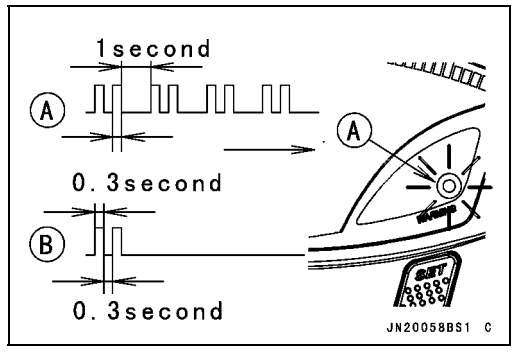



- The user key 2 is successfully pre-registered in the ECU.

○The red warning indicator light (LED) [A] blinks 2 times and stops for 1 second and then repeats this cycle.

**NOTE**

○*Only the first one cycle, the buzzer sounds [B] goes off synchronizing with the blink of the red warning indicator light (LED).*




**Regular Registration of User Key**

- Leave the user key 2 in the ignition switch.
- Press key for a long time (2 seconds or more).

○The ECU confirms the following.
Receiving signals from immobilizer amplifier are correct.
The inserted key is the user key 2.

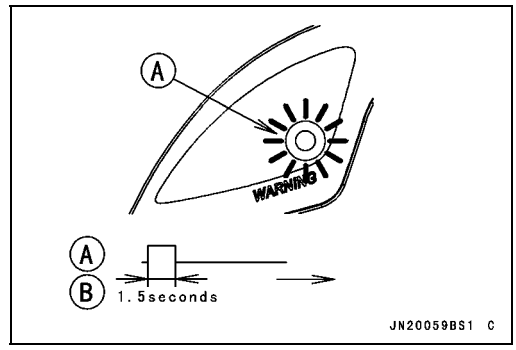
**NOTE**

○*If the inserted key is not the user key 2, the key registration mode will be end instantaneously. Start the procedure again, pre-registration of user key 1.*

## Immobilizer System

- The pre-registered keys are registered regularly in the ECU.

○The red warning indicator light (LED) [A] blinks 1 time for 1.5 seconds and the buzzer sound [B] goes off 1 time synchronizing with the blink of the red warning indicator light (LED).




- The key registration mode automatically ends.

**NOTE**

○*Check that the engine can be started using all registered user keys.*

**Case 3: When the following both keys are faulty or lost.**

FPO Key (orange-colored)
SLO Key (yellow-colored and marked SLO)
If they are required, the following are necessary.

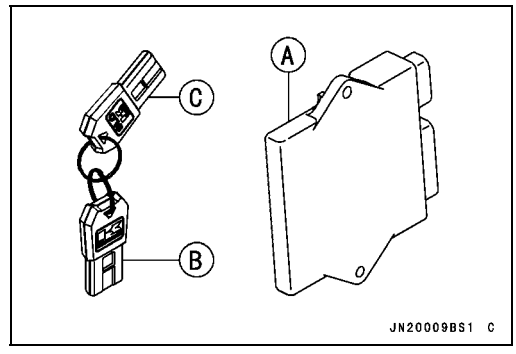
**NOTE**

○*The ECU must be replaced with a new one because the registration mode can not start in the state with no key.*

- Prepare a new ECU [A], new FPO key [B] and new SLO key [C].

**NOTE**

○*The key registration unit is not required.*
○*The key registration process is same as the electric control unit replacement.*




**Case 4: When replacing the immobilizer amplifier (ignition switch).**

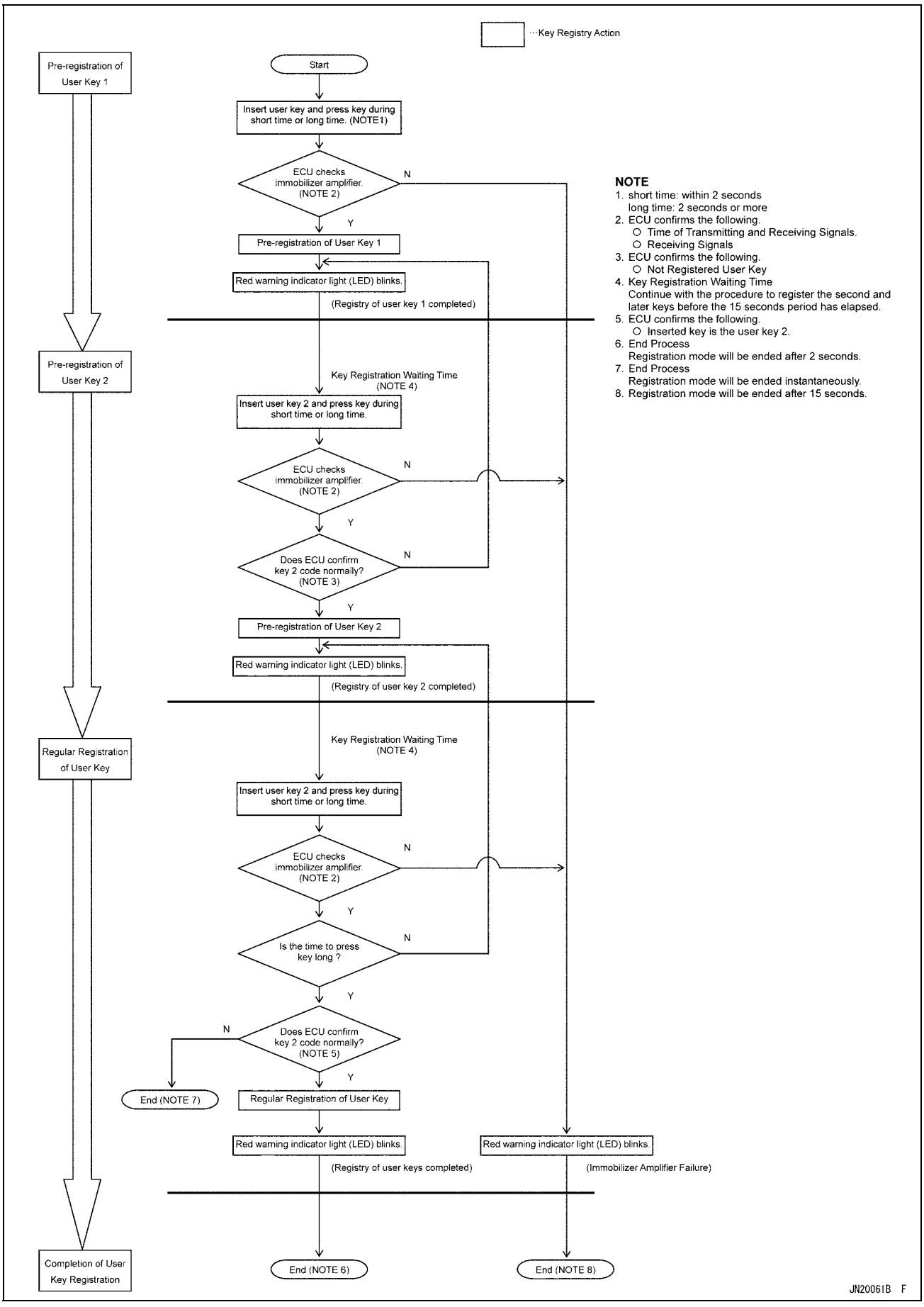
- Prepare a new immobilizer amplifier (ignition switch).
- Refer to the Immobilizer System Parts Replacement.

**NOTE**

○*The key registration unit is not required.*

## Immobilizer System

### All Keys Initial Registration Flow Chart


···Key Registry Action
Pre-registration of User Key 1
Start
Insert user key and press key during short time or long time. (NOTE1)
ECU checks immobilizer amplifier. (NOTE 2)
N
Y
Pre-registration of User Key 1
Red warning indicator light (LED) blinks.
(Registry of user key 1 completed)
Pre-registration of User Key 2
Key Registration Waiting Time (NOTE 4)
Insert user key 2 and press key during short time or long time.
ECU checks immobilizer amplifier. (NOTE 2)
N
Y
Does ECU confirm key 2 code normally? (NOTE 3)
N
Y
Pre-registration of User Key 2
Red warning indicator light (LED) blinks.
(Registry of user key 2 completed)
Regular Registration of User Key
Key Registration Waiting Time (NOTE 4)
Insert user key 2 and press key during short time or long time.
ECU checks immobilizer amplifier. (NOTE 2)
N
Y
Is the time to press key long ?
N
Y
Does ECU confirm key 2 code normally? (NOTE 5)
N
Y
End (NOTE 7)
Regular Registration of User Key
Red warning indicator light (LED) blinks.
(Registry of user keys completed)
Red warning indicator light (LED) blinks.
(Immobilizer Amplifier Failure)
Completion of User Key Registration
End (NOTE 6)
End (NOTE 8)
NOTE
1. short time: within 2 seconds
long time: 2 seconds or more
2. ECU confirms the following.
O Time of Transmitting and Receiving Signals.
O Receiving Signals
3. ECU confirms the following.
O Not Registered User Key
4. Key Registration Waiting Time
Continue with the procedure to register the second and later keys before the 15 seconds period has elapsed.
5. ECU confirms the following.
O Inserted key is the user key 2.
6. End Process
Registration mode will be ended after 2 seconds.
7. End Process
Registration mode will be ended instantaneously.
8. Registration mode will be ended after 15 seconds.
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## Immobilizer System

### *Immobilizer System Parts Replacement*

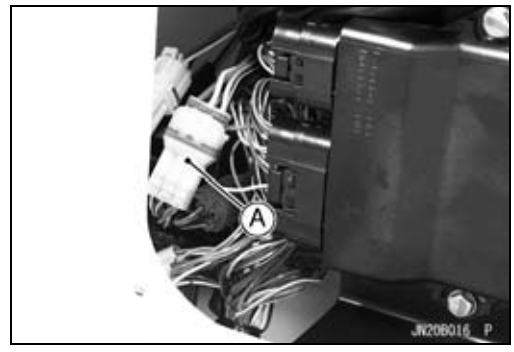
**Immobilizer Amplifier (Ignition Switch) Replacement**

- Move the handlebar to full forward position.
- Remove the center storage lid (see Center Storage Lid Removal/Installation in the Hull/Engine Hood chapter).
- Remove:
  Plate [A]
  Bolts [B] and Washers

**NOTE**

○*Hold the clip nuts [C] on the immobilizer amplifier (ignition switch).*

- Remove the front access cover (see Front Access Cover Removal/Installation in the Hull/Engine Hood chapter).
- Disconnect the immobilizer amplifier (ignition switch) lead connector [A].




- Remove the grommet [A] from the immobilizer amplifier (ignition switch) lead.
- Pull out the immobilizer amplifier (ignition switch).

- Installation is the reverse of removal. Note the following.

**NOTE**

○*Route the immobilizer amplifier (ignition switch) lead not to interfere with the steering cable and shaft.*
○*Install the immobilizer amplifier (ignition switch) so that the letters of the switch faces upward.*

- Replace the seal with a new one.

**ECU (Electric Control Unit) Replacement**

- Refer to ECU Removal and Installation in the Fuel System (DFI) chapter.

## Immobilizer System

### Immobilizer Relational Parts Replacement Chart

| | | Failed or Lost Part | | | |
|---|---|---|---|---|---|
| | | FPO Key (Orange) | SLO Key (Yellow) | Immobilizer Amplifier | ECU |
| * | FPO Key (Orange) | ● | | | |
| | SLO Key (Yellow) | | ● | | |
| | Immobilizer Amplifier | | | ● | |
| | ECU | | | | ● |

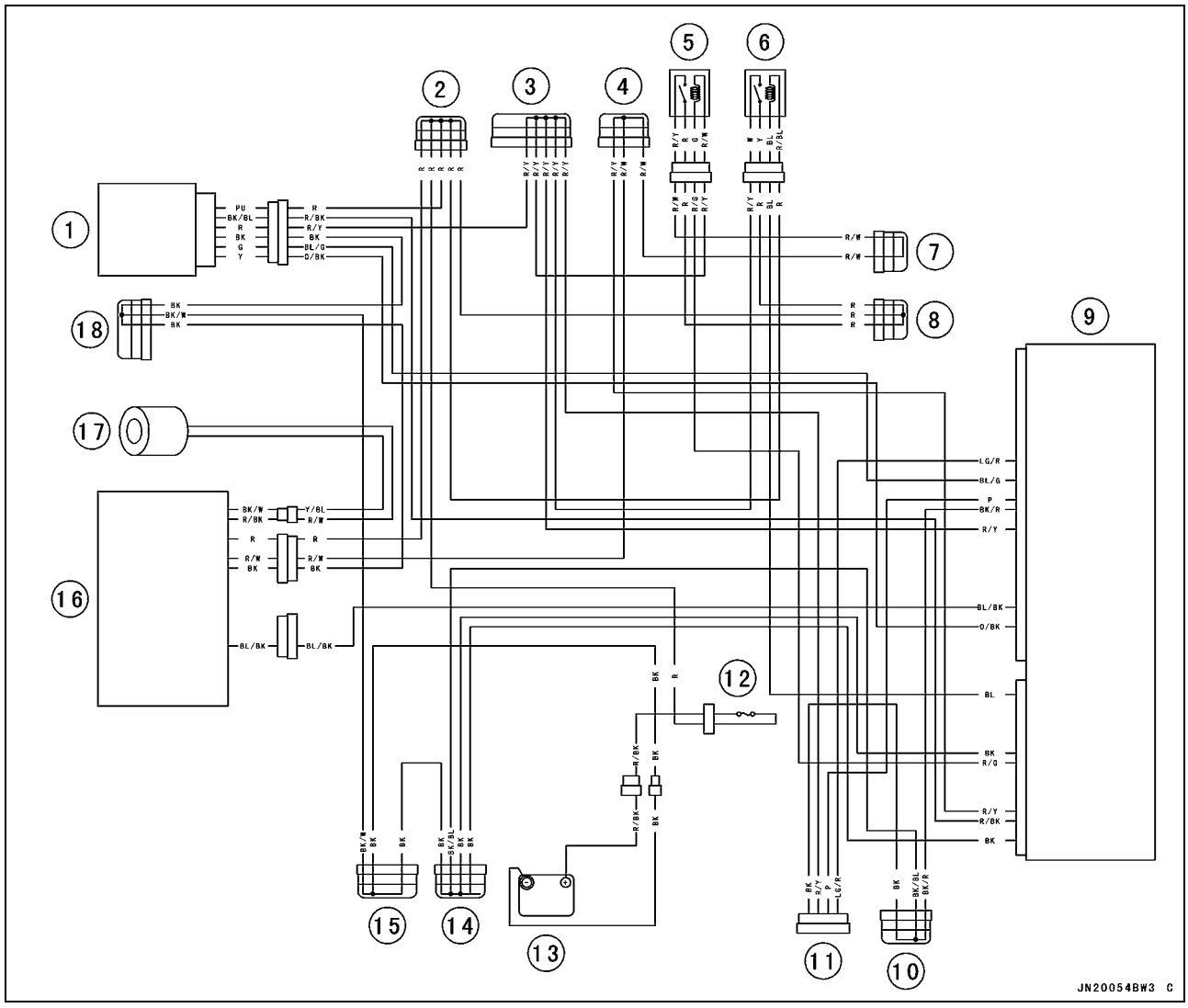
| | |
|---|---|
| * | Replacement Part |
| ● | Main Replacement Part |

### *Immobilizer System Inspection*

- Refer to the Amplifier Input Voltage Inspection in the Fuel System (DFI) chapter.
- Refer to the User Key Inspection in the Fuel System (DFI) chapter.

## Immobilizer System

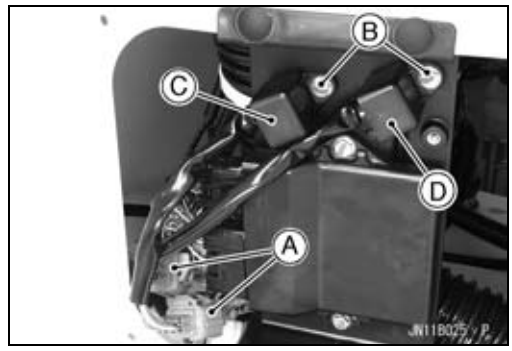
### Immobilizer System Circuit




1. Ignition Switch (Immobilizer Amplifier)
2. Joint Connector P (12 V)
3. Joint Connector R (12 V)
4. Joint Connector T (12 V)
5. ECU Main Relay
6. System Relay
7. Joint Connector D (12 V)
8. Joint Connector C (12 V)
9. ECU
10. Joint Connector E (Ground)
11. Immbilizer/Kawasaki Diagnostic System Connector
12. Main Fuse 20 A
13. Battery
14. Joint Connector Y (Ground)
15. Joint Connector S (Ground)
16. Meter Unit
17. Buzzer
18. Joint Connector Q (Ground)

## Relay Assembly

### *Relay Assembly Removal*




- Remove the front access cover (see Front Access Cover Removal/Installation in the Hull/Engine Hood chapter).
- Remove:
  Relay Connectors [A]
  Relay Mounting Bolts [B]
  ECU Main Relay [C]
  Fuel Pump/System Relay [D]

### *Relay Assembly Installation*

- Installation is the reverse of removal. Note the following.
- Run the leads properly (see Cable, Wire, and Hose Routing section in the Appendix chapter).
- Apply a non-permanent locking agent to the relay mounting bolts.
- Tighten:

**Torque - Relay Mounting Bolts: 2.5 N·m (0.25 kgf·m, 22 in·lb)**

### *Relay Assembly Inspection*

- Remove the relay assembly (see Relay Assembly Removal).
- Check conductivity of the following numbered terminals by connecting the hand tester and one 12 V battery to the relay assembly as shown in the figure.

**Special Tool - Hand Tester: 57001-1394**

★If the tester does not read as specified, replace the relay assembly.

## Relay Assembly

### Relay Assembly Circuit Inspection (with the battery disconnected)

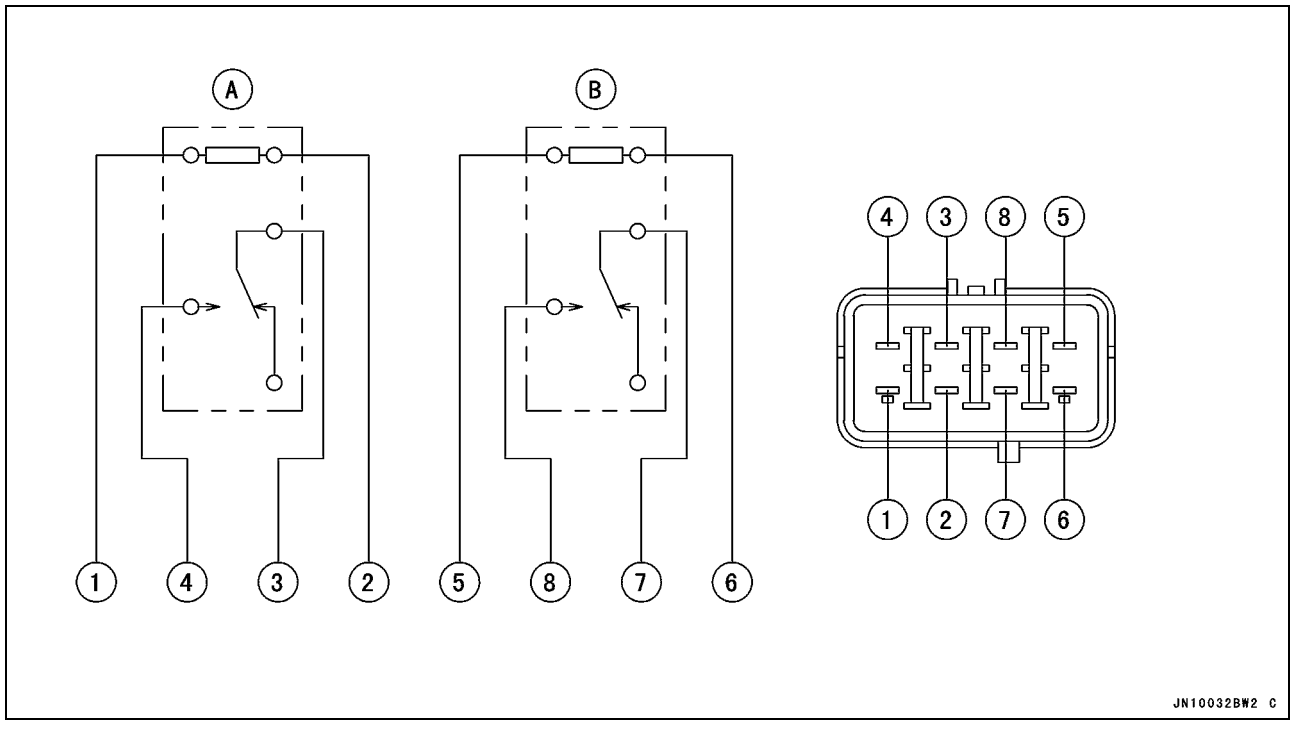
| | Tester Connection | Tester Reading (Ω) |
|---|---|---|
| Main ECU Relay [A]<br>Fuel Pump Relay [A] | 3-4 | ∞ |
| | 1-2 | Not ∞* |
| System Relay [B] | 7-8 | ∞ |
| | 5-6 | Not ∞* |

(*): The actual reading varies with the hand tester used.

### Relay Assembly Circuit Inspection (with the battery connected)

| | Battery Connection (+) (–) | Tester Connection | Tester Reading (Ω) |
|---|---|---|---|
| Main (ECU) Relay [A]<br>Fuel Pump Relay [A] | 1-2 | 3-4 | 0 |
| System Relay [B] | 5-6 | 7-8 | 0 |

(+): Apply positive lead.
(–): Apply negative lead.



## Switches

### *Switch Inspection*

● Using the hand tester, check to see that only the connections shown in the table have continuity.

**Special Tool - Hand Tester: 57001-1394**

○For the ignition switch and switches on the handlebar, refer to the tables in the Wiring Diagram.

★If the switch has an open or short, repair it or replace it with a new one.

**Oil Pressure Switch Connections***

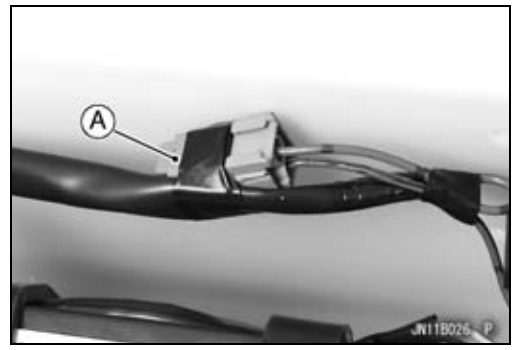
| Oil Pressure Switch Connections * | | |
|---|---|---|
| Color | SW. Terminal | Ground |
| When engine is stopped | ○ | ○ |
| When engine is running | | |

*: Engine lubrication system is in good condition.

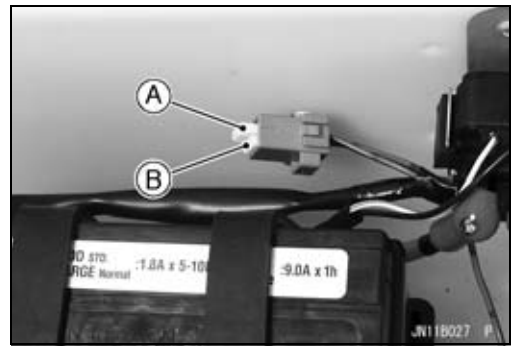
## Fuse

### *Fuse Inspection*

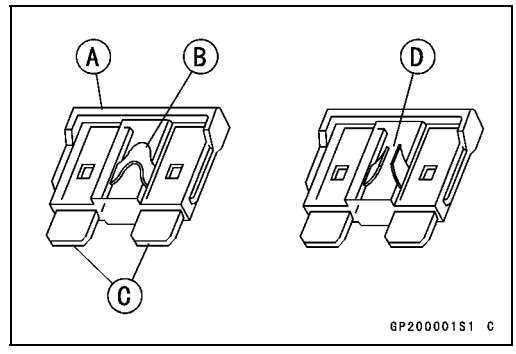
● Remove:
Battery Cover (see Battery Removal)
Fuse Case Cap [A]




● Remove:
Main Fuse 20 A [A]
Spare Fuse 20 A [B]




● Inspect the fuse element.
★If it blown out, replace the fuse. Before replacing a blown fuse, always check the amperage in the affected circuit. If the amperage is equal to or greater than the fuse rating, check the wiring and related components for a short circuit.
Housing [A]
Fuse Element [B]
Terminals [C]
Blown Element [D]




***NOTICE***

**Installation of a fuse with a higher rating may cause damage to wiring and components. When replacing a fuse, be sure the new fuse matches the specified fuse rating for that circuit.**

# Storage

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## Preparation for Storage

During the winter, or whenever the watercraft will not be in use for a long period of time, proper storage is essential. It consists of checking and replacing missing or worn parts; lubricating parts to ensure that they do not become rusted; and, in general, preparing the watercraft so that when the time comes to use it again, it will be in top condition.

**NOTICE**

**Since Jet Ski personal watercraft are not designed to be docked in the water for extended periods, prolonged immersion in water will cause the hull paint to bubble and peel, as well as electrolytic erosion of some metal parts in the jet pump. To prevent paint damage and electrolytic erosion, remove your Jet Ski watercraft from the water at the end of each day's use; do not leave it in the water overnight. Your Jet Ski watercraft will last longer and look better if you remove it from the water at the end of every day's use.**

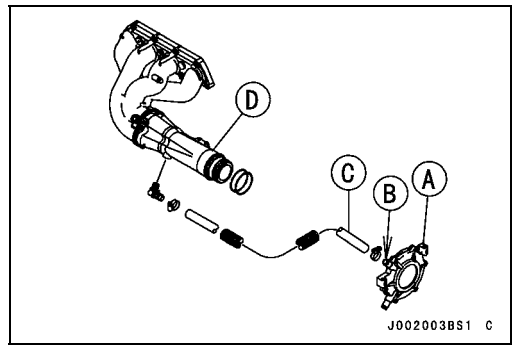
### *Cooling System*

- Clean the cooling system (see Cooling System Flushing in the Periodic Maintenance chapter).
- When storing the watercraft in an area where the temperature drops below freezing, perform the following.

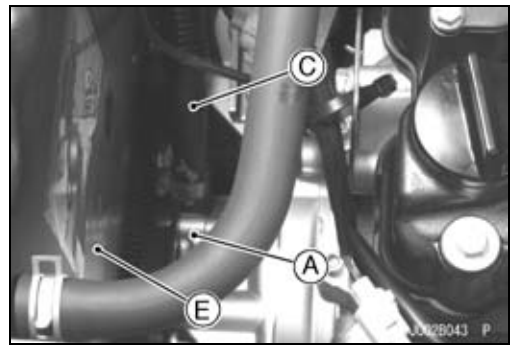
### *Discharging water in the exhaust system*

**NOTICE**

**Water in the exhaust system could freeze during cold weather and damage the exhaust pipe. Discharge water from the exhaust system after flushing the cooling system.**




- After flushing, remove the cooling water hose [C] from the fitting [B] on the engine output cover [A] at the rear of the engine. Lead the hose to the lowest level in the engine room so that water remaining in the exhaust pipe [D] drains out.
  Air Box [E]
- Connect the hose to fitting on the output cover and tighten the clamp securely.

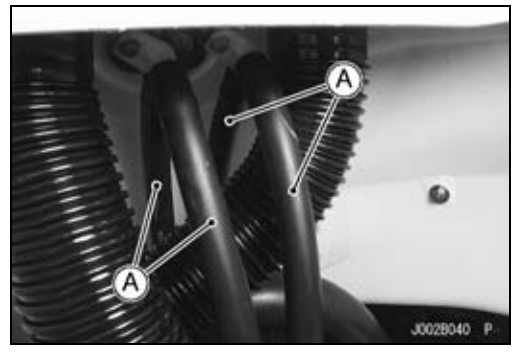



**NOTICE**

**If the hose comes off during operation, cooling water could swamp the boat.**
**Connect the hose securely to the fitting.**
**If you are not confident you can perform storage procedures, ask your Kawasaki JET SKi watercraft dealer for this service.**

## Preparation for Storage

### *Bilge System*




- Clean the bilge system (see Bilge System Flushing in the Periodic Maintenance chapter). Before reconnecting the hoses to the plastic breather fitting, blow air through both hoses [A] to force all water out of the bilge system.

### *Engine Oil*

- Change the engine oil (see Engine Oil Change in the Periodic Maintenance chapter).

### *Fuel System*

**⚠ WARNING**

**Gasoline is extremely flammable and can be explosive under certain conditions, creating the potential for serious burns. Make sure the area is well ventilated and free from any source of flame or sparks; this includes any appliance with a pilot light. Do not smoke. Remove the ignition key. Be prepared for fuel spillage; any spilled fuel must be completely wiped up immediately.**

- Drain the fuel tank. This should be done with a siphon or pump.
  Siphon Hose [A]

**NOTE**

○*Lift the stern upward a little so that fuel and water in the bottom of the fuel tank may flow toward the fuel filter to completely drain the fuel tank.*

- Remove the fuel pump (see Fuel Pump Removal in the Fuel System (DFI) chapter).
- Clean the fuel pump screen [A] (see Fuel Pump Screen Cleaning in the Periodic Maintenance chapter).
- Refill the fuel tank with fresh fuel approximately 10 L (2.6 gal U.S.).
- Insert the ignition key in the ignition switch to turn it on.
- Push the lanyard key under the stop button, and start the engine and run it in 15 second periods until all fuel in the fuel system is with fresh fuel. Wait 5 minutes between 15 seconds running periods.

***NOTICE***

**Operating the engine without cooling water for more than 15 seconds, especially at high rpm, will cause severe engine and exhaust system damage. To avoid engine damage, do not run the engine without providing sufficient cooling water.**

- Pull the lanyard key off the stop button and remove the ignition key.
- Drain the fuel tank.
- Leave the fuel filler cap loose to prevent condensation in the tank.

## Preparation for Storage

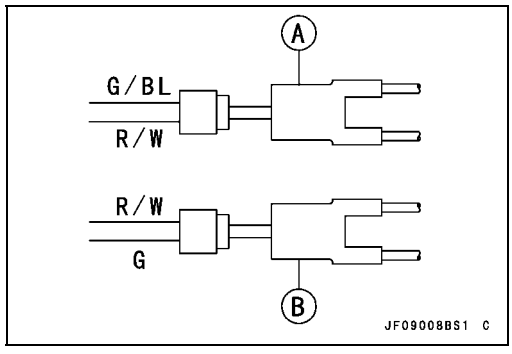
### *Engine*

- Remove the seats (see Seat Removal in the Hull/Engine Hood chapter).
- Disconnect both two connection on the ignition coil primary lead connectors [A].
- Remove the spark plugs (see Spark Plug Inspection in the Periodic Maintenance chapter).
- Spray fogging oil directly into each cylinder.
- Insert the ignition key in the ignition switch to turn it on.
- Push the lanyard key under the stop button. Turn the engine over several times with the start button to coat the cylinder walls with oil.

**⚠ WARNING**

**The engine and exhaust system get extremely hot during normal operation and can cause serious burns. Never touch the engine or exhaust pipe during clutch adjustment.**

- Pull the lanyard key off the stop button and remove the ignition key.
- Spray the spark plugs with fogging oil, and reinstall the spark plugs and caps (see Spark Plug Inspection in the Periodic Maintenance chapter).

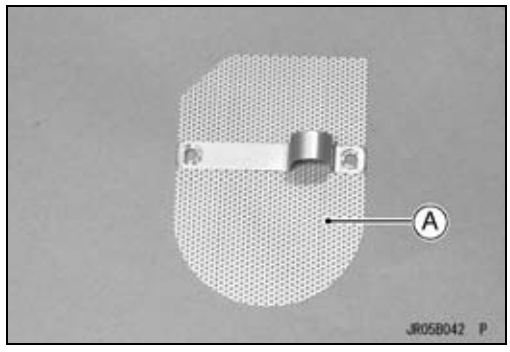



- Reconnect the primary ignition coil lead connectors, noting the #1, #4 [A] and the #2, #3 [B] coil connectors. The #1, #4 coil connector has a red/white and a green/blue leads from the main harness. The #2, #3 coil connector has a red/white and green leads from the main harness.

**NOTE**

○*The service codes (51 and 52) caused by this procedure are stored in the ECU.*

### *Air Box*




- Disassemble the air box (see Air Box Disassembly in the Fuel (DFI) System chapter).
- Wash and dry the flame arrester [A].
- Assemble and install the air box (see Air Box Assembly/Installation in the Fuel (DFI) System chapter).

### *Battery*

- Give a refresh charge before you store the watercraft and store it with the negative lead removed. Give a refresh charge once a month during storage.
- Remove the battery (see Battery Remove in the Electrical System chapter).
- Clean the exterior with a solution of baking soda and water (one heaping tablespoon of baking soda in one cup of water). Rinse thoroughly with water.
- Coat both battery terminals with grease.
- Store the battery in a cool, dry place. Do not expose it to freezing temperatures.

## Preparation for Storage

### *Lubrication*

- Carry out all recommended lubrication procedures (see Lubrication in Periodic Maintenance chapter).

### *Lube Jet Pump Bearings/Seals*

***NOTICE***

**Failure to properly maintain the jet pump bearings can lead to premature failure and cause severe engine damage. The jet pump bearings and seals should be serviced prior to prolonged storage to prevent any water that may be left in the pump from corroding the bearings and causing premature failure.**

- Clean the pump (see Lube Jet Pump Bearing and Seal Inspection in the Periodic Maintenance chapter).

### *Cleaning*

- Wash the engine compartment with fresh water and remove the drain screw in the stern to drain the water. Wipe up any water left in the compartment.

***NOTICE***

**Harsh solvents may attack the surface or smear the colors of the hull. Use only a mild detergent in water to wash the hull.**

- Apply a good grade of wax to all exterior hull surfaces.
- Lightly spray all exposed metal parts with a penetrating rust inhibitor.
- Remove the seat, or block the seat up with 10 mm (0.39 in.) spacers to insure adequate ventilation, and prevent corrosion.
- Cover the watercraft and store it in a clean, dry place.

## Removal from Storage

### *Lubrication*

- Carry out all recommended lubrication procedures (see the Periodic Maintenance chapter).

### *General Inspection*

- Check for binding or sticking throttle, steering or shift mechanism. The throttle lever must return fully when released.
- Clean and gap spark plugs (see Spark Plug in the Periodic Maintenance chapter).
- Check all rubber hoses for weathering a cracking, or looseness.
- Check that the drain screw in the stern is securely tightened.
- Check the fire extinguisher for a full charge.
- Check the battery, charge if necessary, and clean the terminals. Install the battery (see Battery Installation in Electrical System chapter).

### *Fuel System*

- Check and clean or replace the fuel pump screens as necessary (see Fuel Pump Screen Cleaning in the Periodic Maintenance chapter).

**⚠ WARNING**

**Gasoline is extremely flammable and can be explosive under certain conditions, creating the potential for serious burns. Make sure the area is well ventilated and free from any source of flame or sparks; this includes any appliance with a pilot light. Do not smoke. Remove the ignition key. Be prepared for fuel spillage; any spilled fuel must be completely wiped up immediately.**

- After refueling and before starting the engine, tilt the seat to the rear for several minutes to ventilate the engine compartment.

**⚠ WARNING**

**A concentration of gasoline fumes in the engine compartment can cause a fire or explosion. To prevent a fire or explosion, remove the seat to vent the engine compartment.**

- Check for fuel leaks. Repair if necessary.
- Check the engine oil level. Fill the oil with the specified oil.

## Removal from Storage

### *Test Run*

**⚠ DANGER**

**Exhaust gas contains carbon monoxide, a colorless, odorless poisonous gas. Inhaling carbon monoxide can cause serious brain injury or death. DO NOT run the engine in enclosed areas. Operate only in a well-ventilated area.**

- Start the engine and run it only for 15 seconds. Check for fuel, oil and exhaust leaks. Any leaks must be repaired.

***NOTICE***

**Operating the engine without cooling water for more than 15 seconds, especially at high rpm, will cause severe engine and exhaust system damage. To avoid engine damage, do not run the engine without providing sufficient cooling water.**

- Install the seat making sure it is locked.

# Appendix

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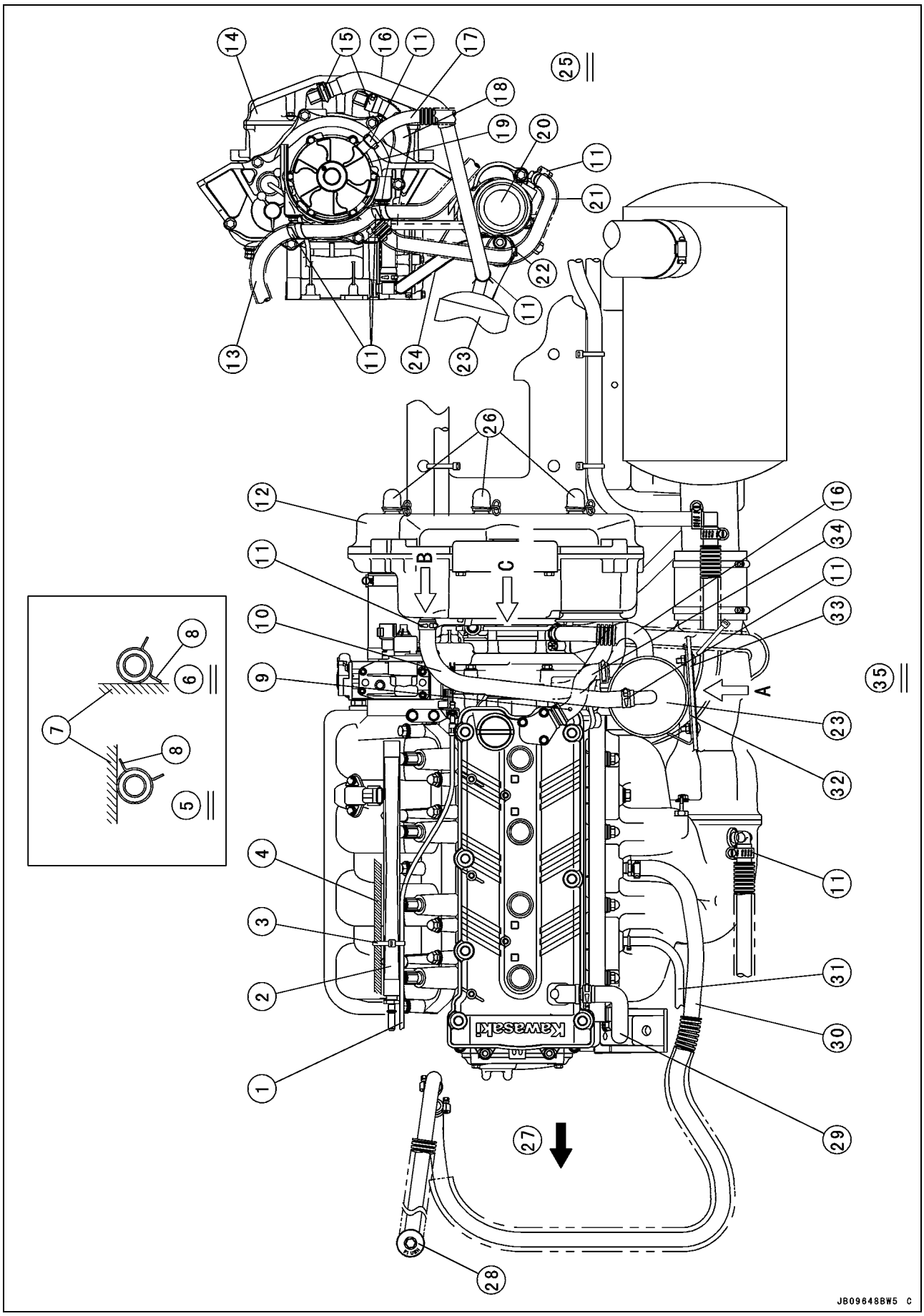
Troubleshooting Guide ..... 16-26

## Cable, Wire and Hose Routing

### Oil Hose Routing

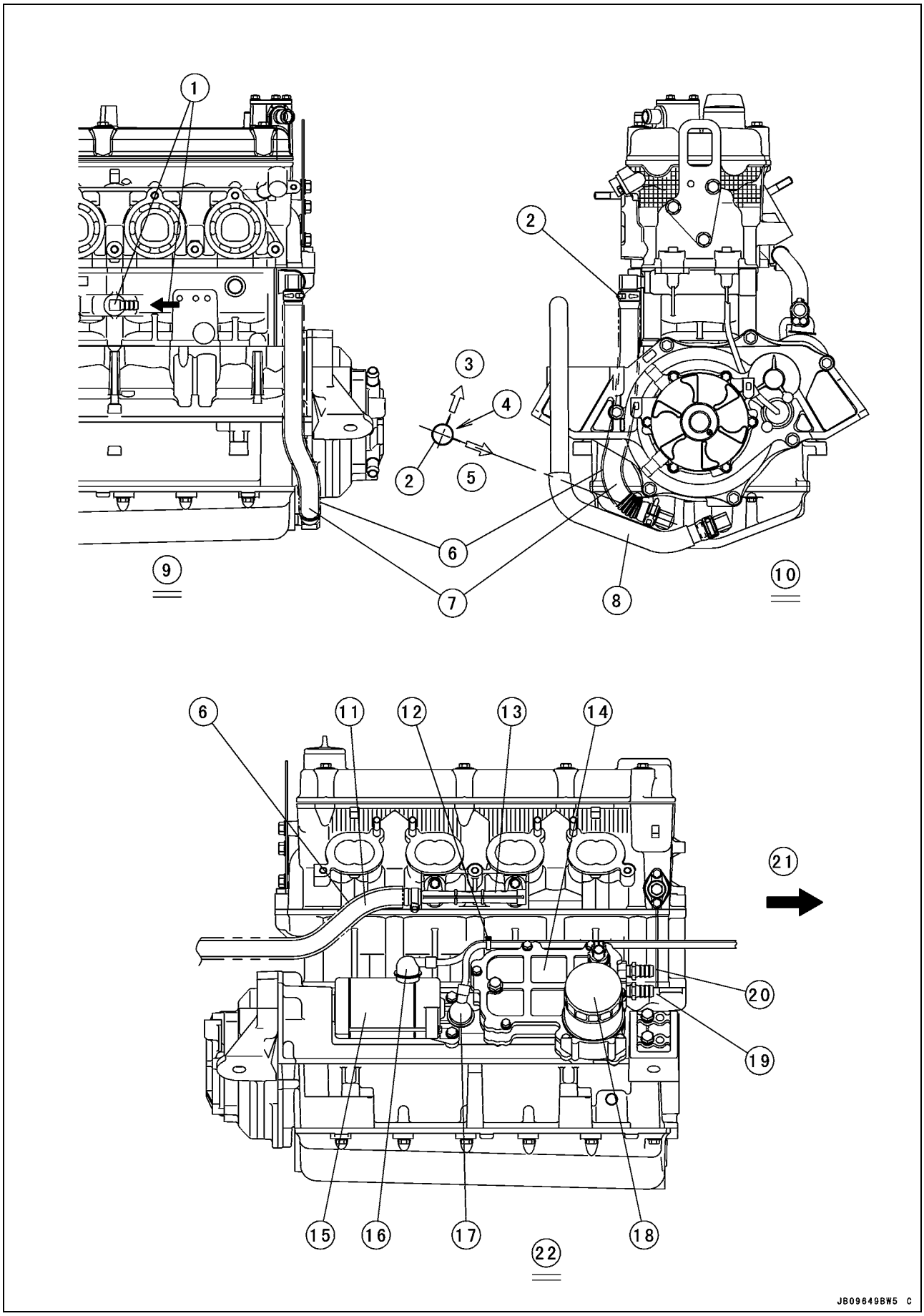


## Cable, Wire and Hose Routing

1. Throttle Cable
2. Delivery Pipe
3. Fix the main harness and throttle cable to the delivery pipe with the band.
4. Main Harness
5. View from A
6. View from B
7. Horizontal Plane
8. Position the clamp pinch head below the horizontal plane.
9. White Mark
10. Oil Separator Tank Hose (Tank ~ Air Box)
11. Clamps
12. Air Box
13. Cooling Hose (Cylinder ~ Left Water Box Muffler)
14. Oil Pan
15. Position the clamp pinch head as shown.
16. Oil Separator Tank Hose (Tank ~ Oil Pan)
17. Cooling Hose (Pump ~ Output Cover)
18. Return Oil Hose (Cylinder ~ Oil Pan)
19. Output Cover
20. Exhaust Pipe
21. Cooling Hose (Output Cover ~ Exhaust Pipe)
22. Band
23. Oil Separator Tank
24. Cooling Hose (Left Water Box Muffler ~ Cylinder)
25. View from C
26. Air Box Drain Caps
27. Bow
28. Flushing Cap
29. Breather Hose (Cylinder Head ~ Breather Case)
30. Flushing Hose
31. Bypass Outlet Hose
32. Plate
33. Deck (Port Side)
34. Oil Separator Tank Hose (Cylinder Head Cover ~ Tank)
35. View from Top

## Cable, Wire and Hose Routing

### Oil and Cooling Hoses Routing

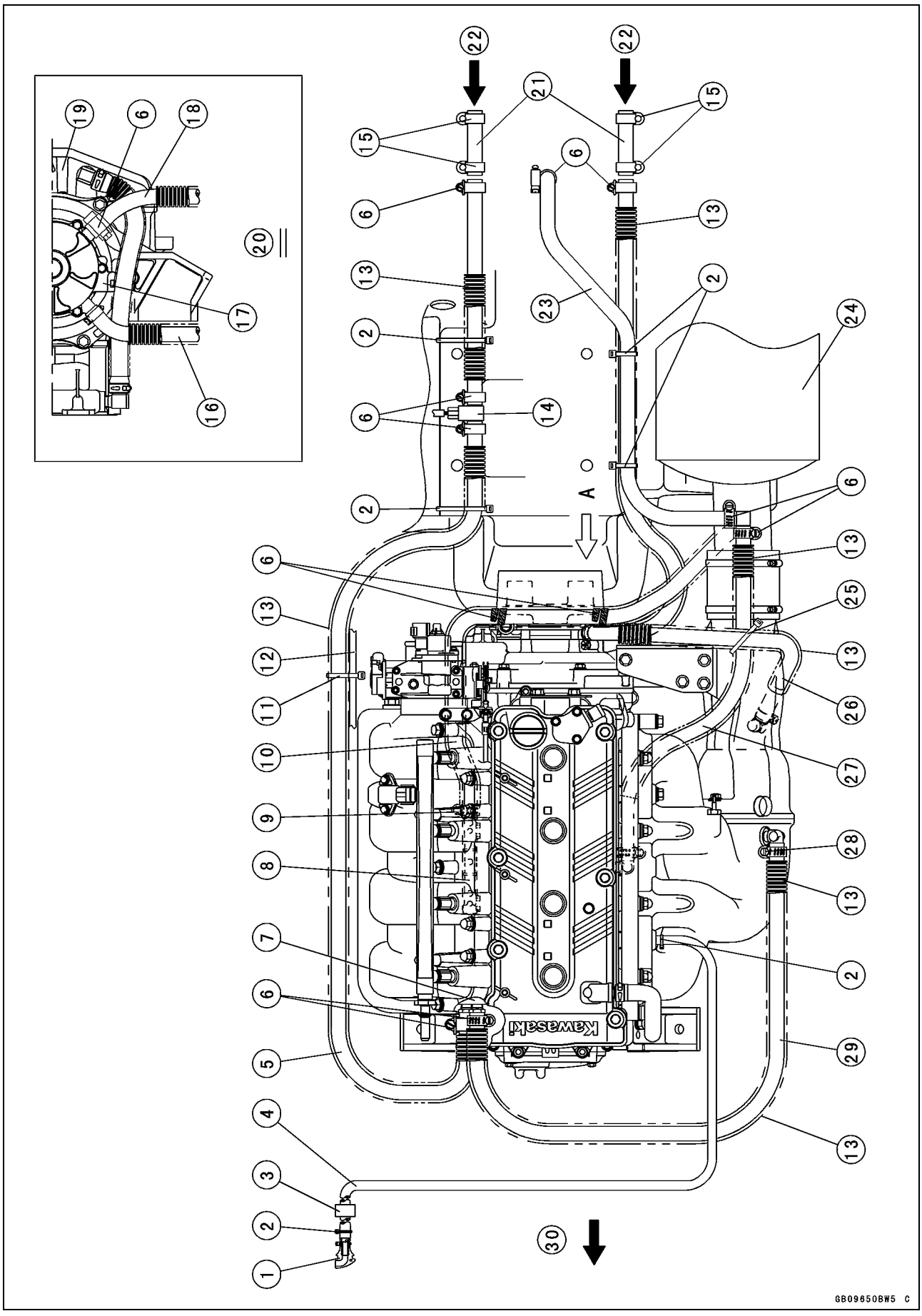


## Cable, Wire and Hose Routing

1. Water Pipe Joint on the Cylinder (Cooling Water from Water Box Muffler)
2. Clamps
3. Front Pinch Head
4. Position the clamp so that its pinch heads do not touch the oil separator tank hose.
5. Rear Pinch Head
6. Protective Tubes
7. Return Oil Hose (Cylinder ~ Oil Pan)
8. Oil Separator Tank Hose (Oil Separator Tank ~ Oil Pan)
9. View from Port Side
10. View from Stern
11. Cooling Hose (Cylinder Head ~ Left Water Box Muffler)
12. Clamp the starter motor and battery (–) cables with the band.
13. Water Pipe
14. Oil Cooler
15. Starter Motor
16. Starter Motor Cable
17. Battery (−) Cable
18. Oil Filter
19. Water Hose Joint (Intake)
20. Water Hose Joint (Outlet)
21. Bow
22. View from Starboard Side

## Cable, Wire and Hose Routing

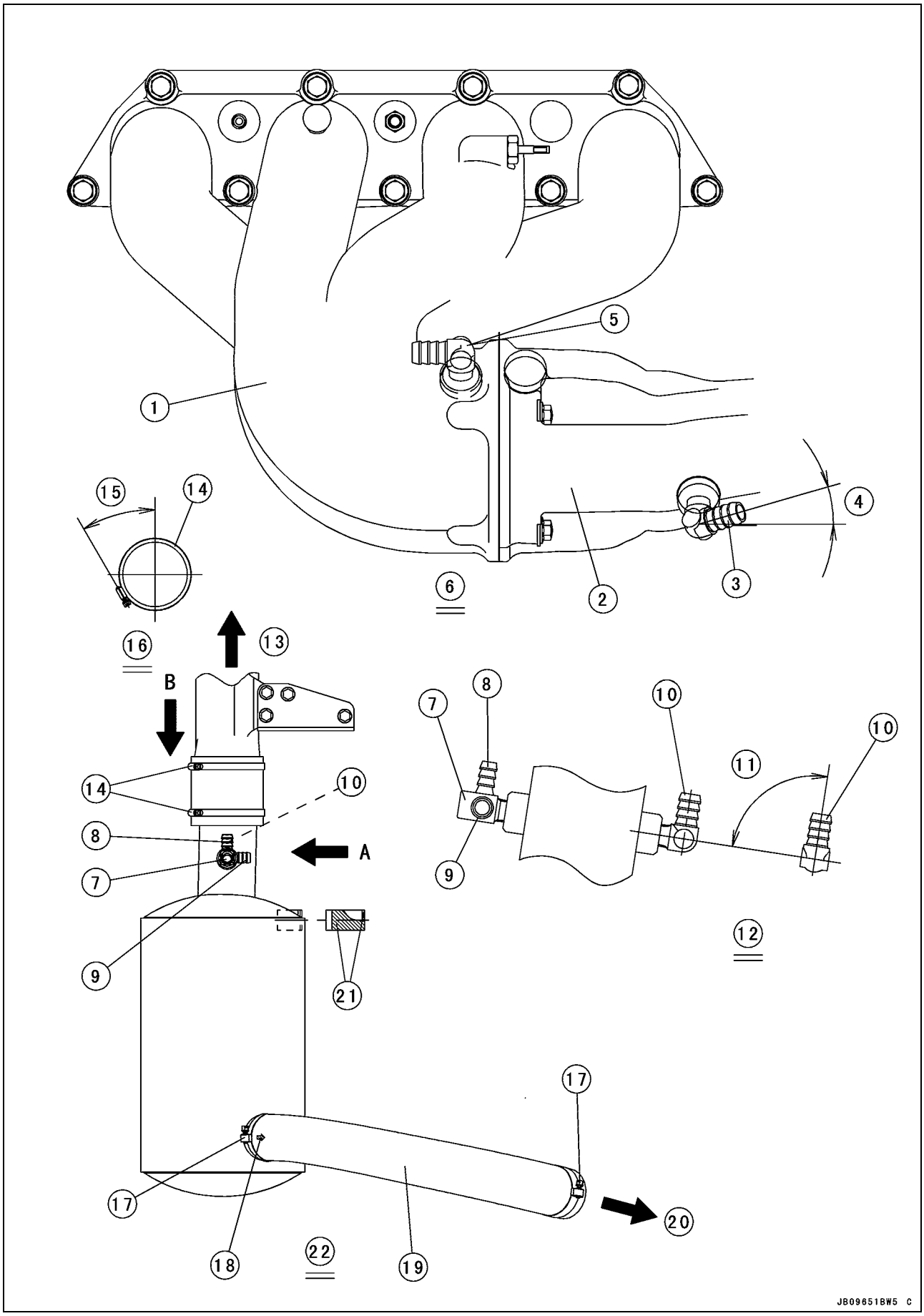
### Cooling Hose Routing



## Cable, Wire and Hose Routing

1. Bypass Outlet
2. Bands
3. Holder
4. Bypass Outlet Hose
5. Cooling Hose (Pump ~ Oil Cooler)
6. Clamps
7. Oil Cooler
8. Water Pipe on the Cylinder Head
9. Position the clamp screw head as shown.
10. Cooling Hose (Cylinder Head ~ Water Pipe Joint under the Water Box Muffler)
11. Fix the cooling hose and the steering cable with the band.
12. Steering Cable
13. Protective Tubes
14. Water Temperature Sensor
15. Position the clamp so that its screw head faces downward and outside.
16. Cooling Hose (Output Cover ~ Exhaust Pipe)
17. Output Cover
18. Cooling Hose (Pump ~ Output Cover)
19. Oil Pan
20. View from A
21. Cooling Hose (Pump ~ Hull)
22. Pump
23. Cooling Hose (Water Box Muffler ~ Hull)
24. Water Box Muffler
25. Fix the No.10 and No.14 cooling hoses with the band.
26. Cooling Hose (Output Cover ~ Exhaust Pipe)
27. Cooling Hose (Water Box Muffler ~ Cylinder)
28. Position the clamp so that its screw head faces inside.
29. Cooling Hose (Oil Cooler ~ Exhaust Manifold)
30. Bow

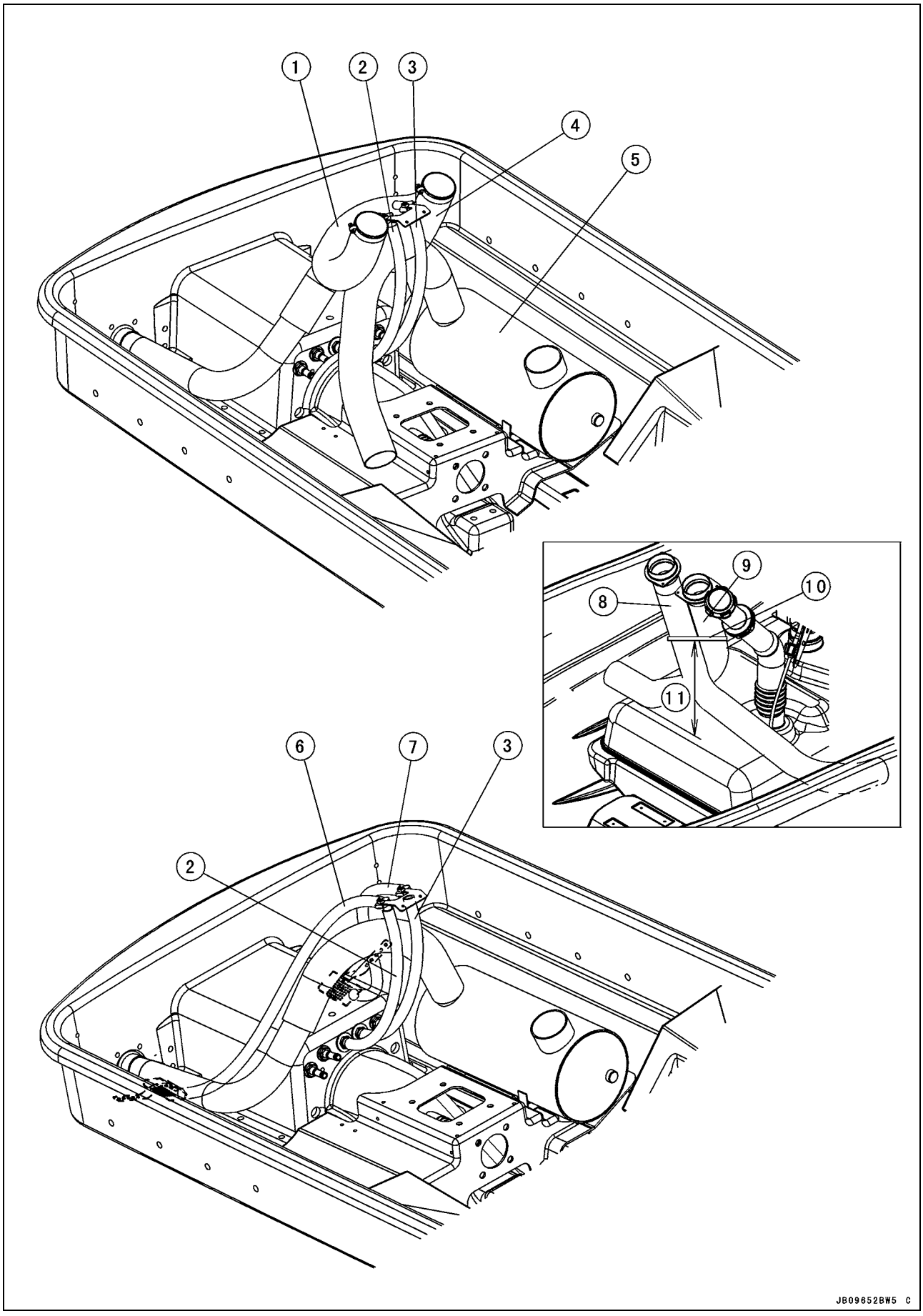
## Cable, Wire and Hose Routing



## Cable, Wire and Hose Routing

1. Exhaust Manifold
2. Exhaust Pipe
3. Water Hose Joint (Cooling Hose from the Output Cover)
4. 30°
5. Water Hose Joint (Cooling Hose from the Oil Cooler)
6. View from Port Side
7. Upper Water Hose Joint
8. Water Hose Joint (Water Box Muffler ~ Cylinder)
9. Water Hose Joint (Water Box Muffler ~ Hull)
10. Lower Water Hose Joint
11. 90°
12. View from A
13. Bow
14. Clamps
15. 30°
16. View from B
17. Position the clamp so that their screw heads face to bow side.
18. Arrow Mark
19. Exhaust Hose
20. To Tail Pipe
21. Dampers
22. View from Top

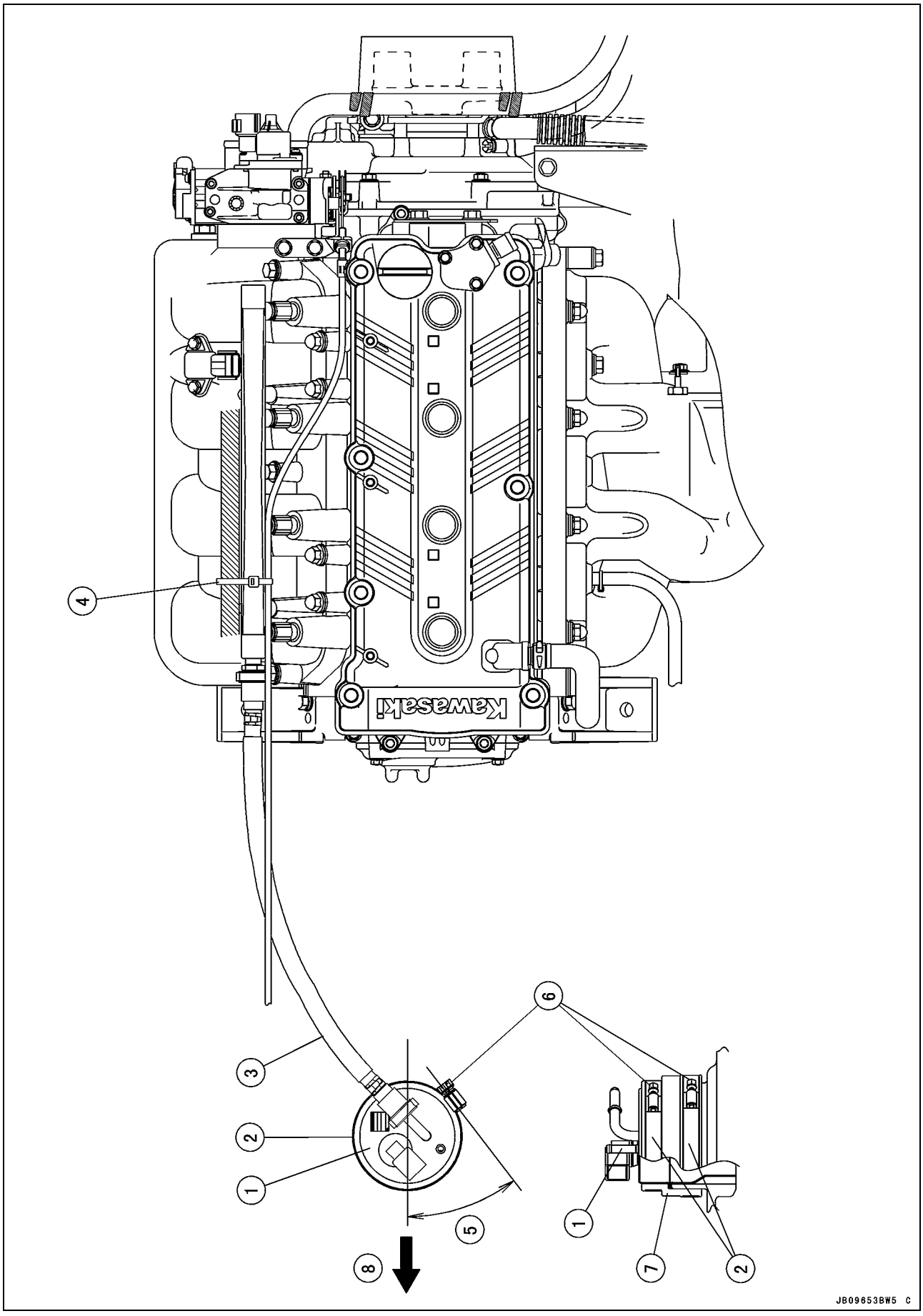
## Cable, Wire and Hose Routing



## Cable, Wire and Hose Routing

1. Right Rear Duct
2. Right Bilge Hose
3. Left Bilge Hose
4. Left Rear Duct
5. Water Box Muffler
6. Right Bilge Breather Hose
7. Left Bilge Breather Hose
8. Right Front Duct
9. Left Front Duct (Run the left front duct through the right front duct rearward.)
10. Band
11. 225 mm (8.86 in.)

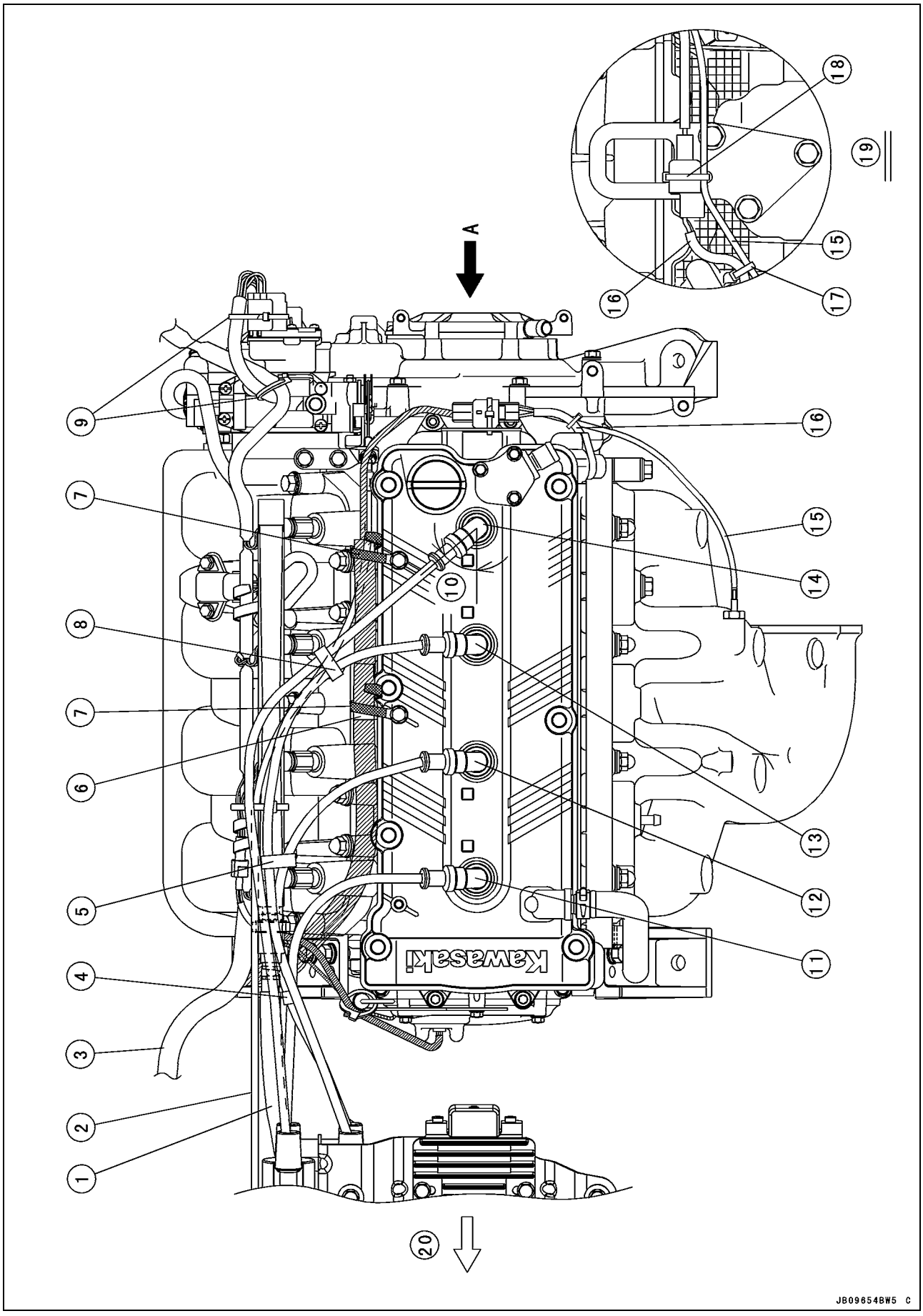
## Cable, Wire and Hose Routing



## Cable, Wire and Hose Routing

1. Fuel Pump
2. Clamps
3. Fuel Hose
4. Fix the main harness and throttle cable to the delivery pipe with the band.
5. 40°
6. Position the clamp screws as shown.
7. Holder
8. Bow

## Cable, Wire and Hose Routing

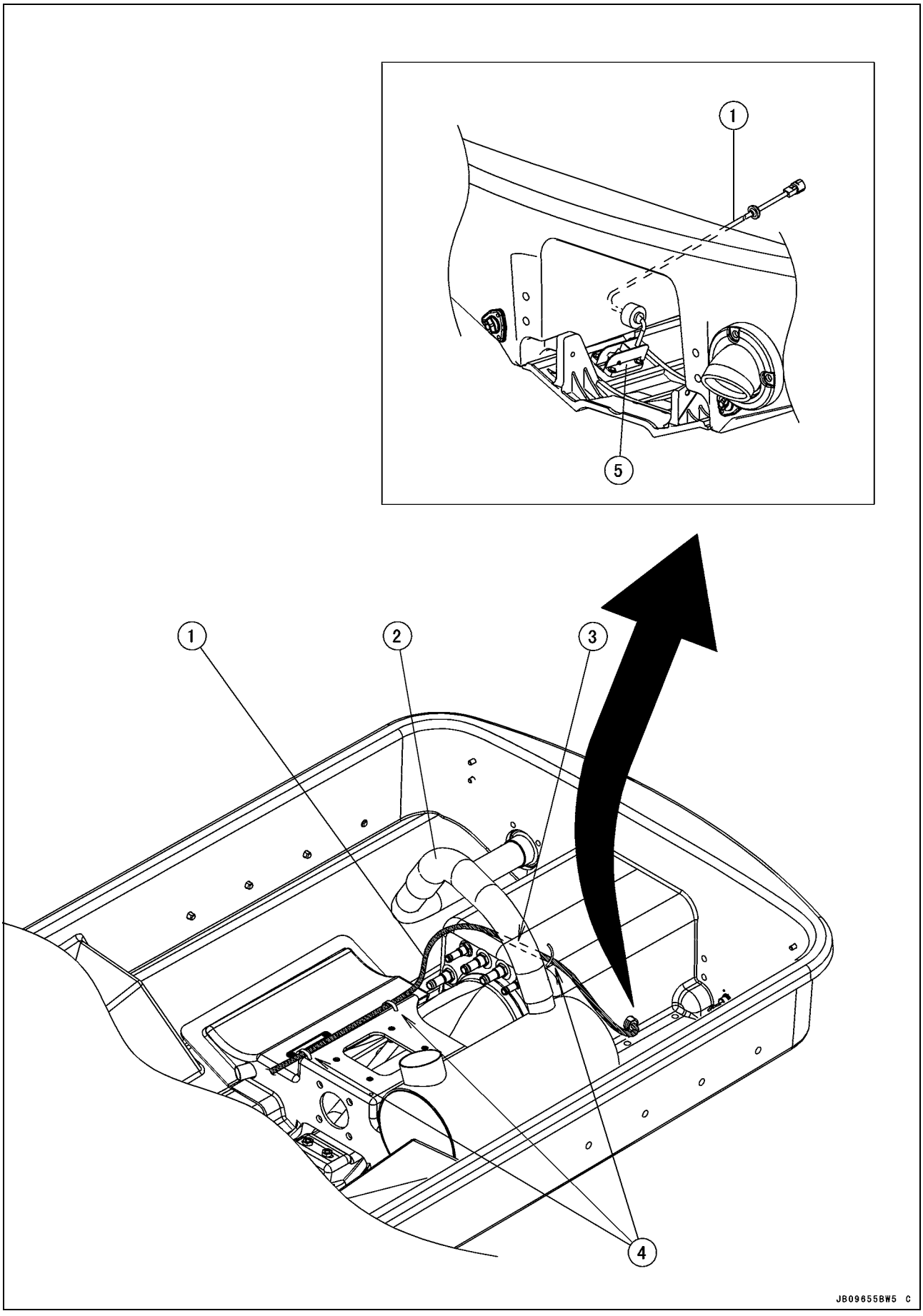


## Cable, Wire and Hose Routing

1. Fuel Hose
2. Throttle Cable
3. Main Harness
4. Fix the #1 and #2 spark plug leads with the clamp.
5. Fix the #2 and #3 spark plug leads with the clamp.
6. White Tape
7. Fix the main harness with the clamps.
8. Fix the #3 and #4 spark plug leads with the clamp.
9. Bands
10. 50°
11. The #1 spark plug lead must be positioned at a right angle to the engine center line.
12. The #2 spark plug lead must be positioned at a right angle to the engine center line.
13. The #3 spark plug lead must be positioned at a right angle to the engine center line.
14. The #4 spark plug lead must be positioned at 50 degrees to the engine center line.
15. Water Temperature Sensor Lead
16. Camshaft Position Sensor Lead
17. Fix the camshaft position sensor lead and water temperature sensor lead with the band.
18. Fix the camshaft position sensor connector and water temperature sensor lead to the engine hook with the band.
19. View from A
20. Bow

## Cable, Wire and Hose Routing

### Speed Sensor Lead Routing

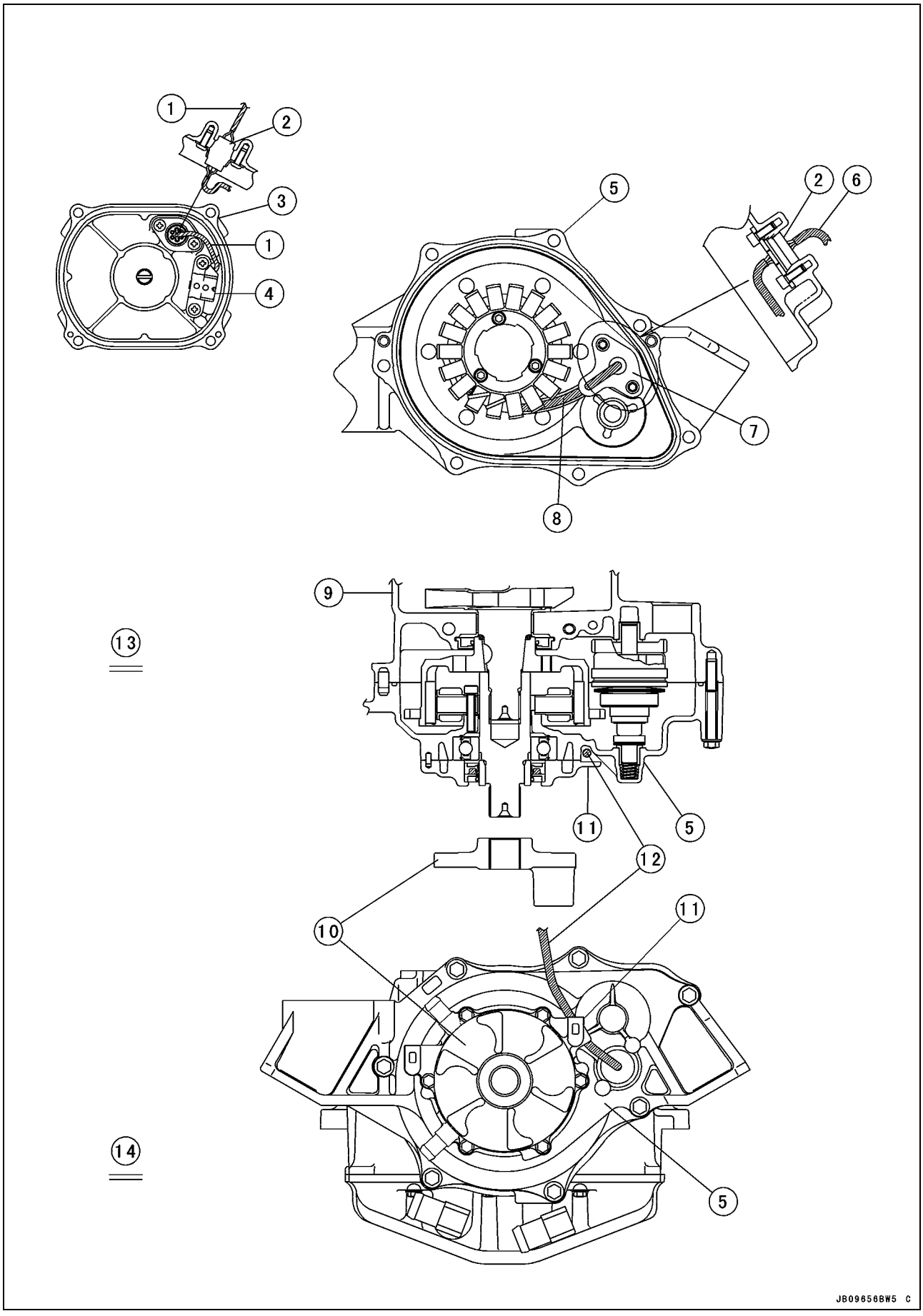


## Cable, Wire and Hose Routing

1. Speed Sensor Lead
2. Exhaust Hose
3. Run the speed sensor lead through the exhaust hose rearward.
4. Bands
5. Speed Sensor

## Cable, Wire and Hose Routing

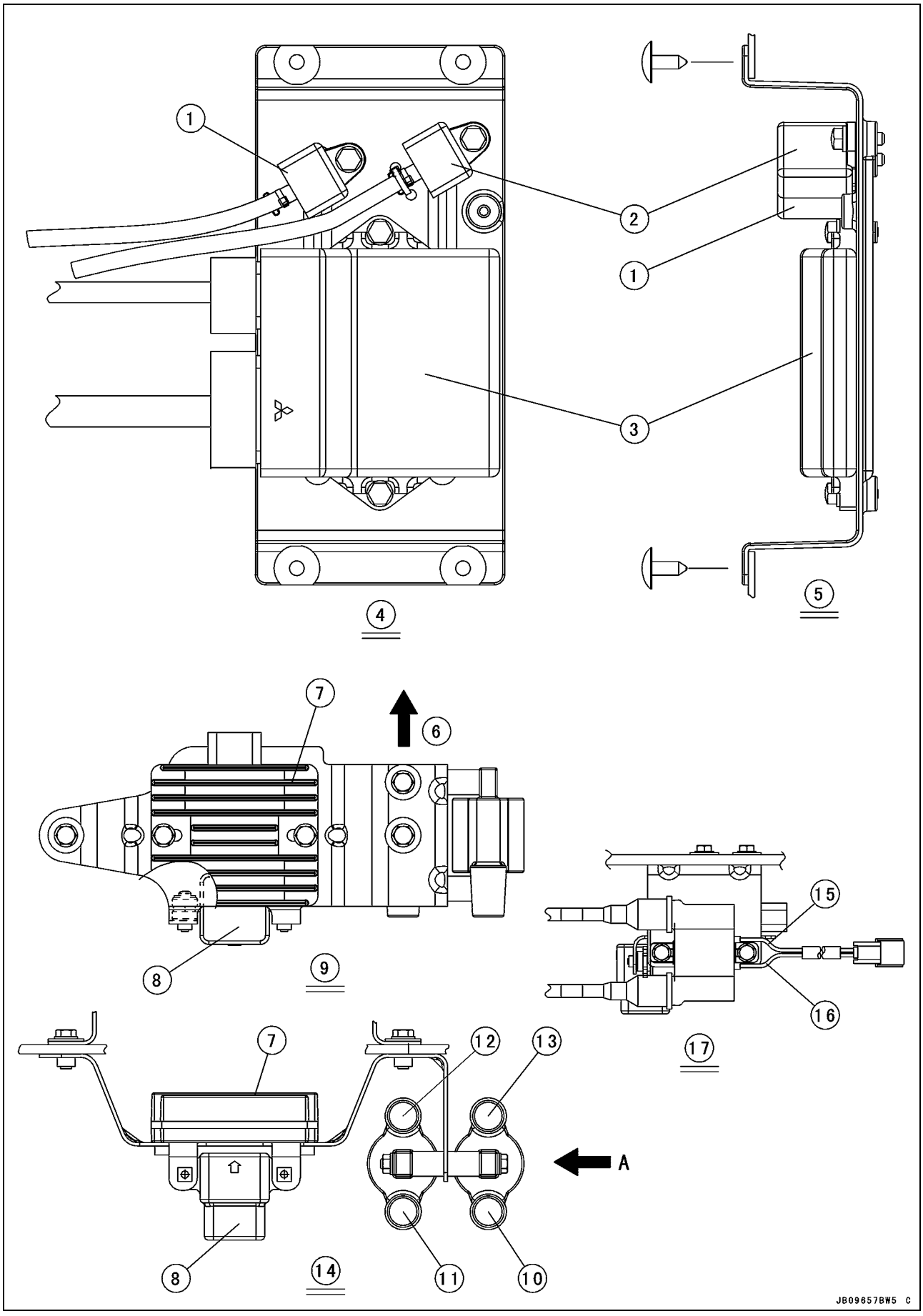
### Wire Routing at Crankshaft Sensor and Alternator Cover



## Cable, Wire and Hose Routing

1. Crankshaft Sensor Leads
2. Grommet
3. Crankshaft Sensor Cover
4. Crankshaft Sensor
5. Alternator Cover
6. Stator Coil Leads
7. Plate for holding the stator coil leads: Do not place the leads between the plate and alternator cover.
8. Run the stator coil leads along the hollow of the alternator cover.
9. Crankcase
10. Coupling
11. Output Cover
12. Run the stator coil leads between the alternator cover and output cover. Do not pinch the leads.
13. View from Top
14. View from Stern

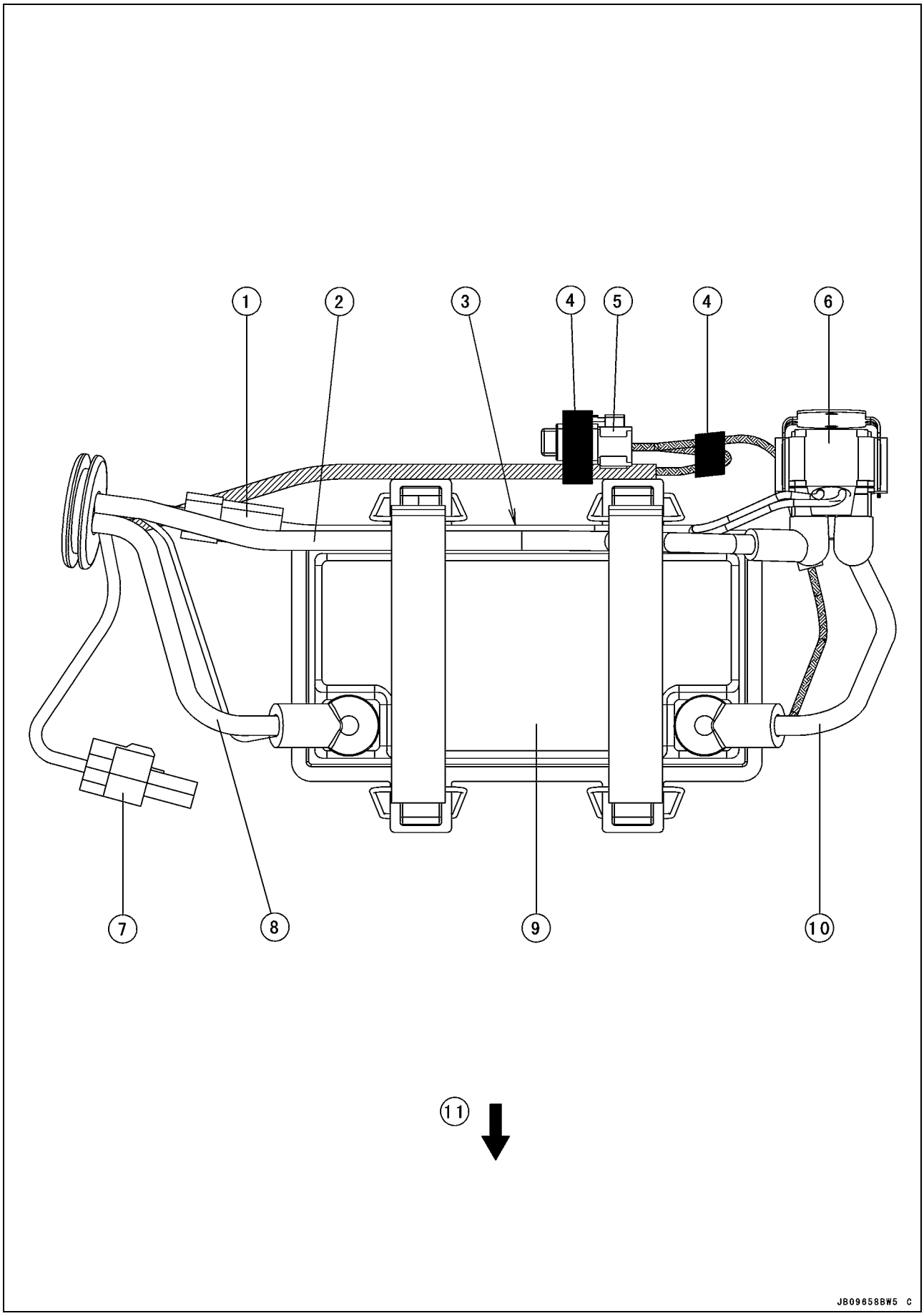
## Cable, Wire and Hose Routing



## Cable, Wire and Hose Routing

1. ECU Main Relay
2. Fuel Pump Relay/System Relay
3. ECU
4. View from Bow
5. View from Port Side
6. Bow
7. Regulator/Rectifier
8. Vehicle-down Sensor
9. View from Top
10. #1 Ignition Coil Lead
11. #2 Ignition Coil Lead
12. #3 Ignition Coil Lead
13. #4 Ignition Coil Lead
14. View from Stern
15. Black Lead
16. Red Lead
17. View from A

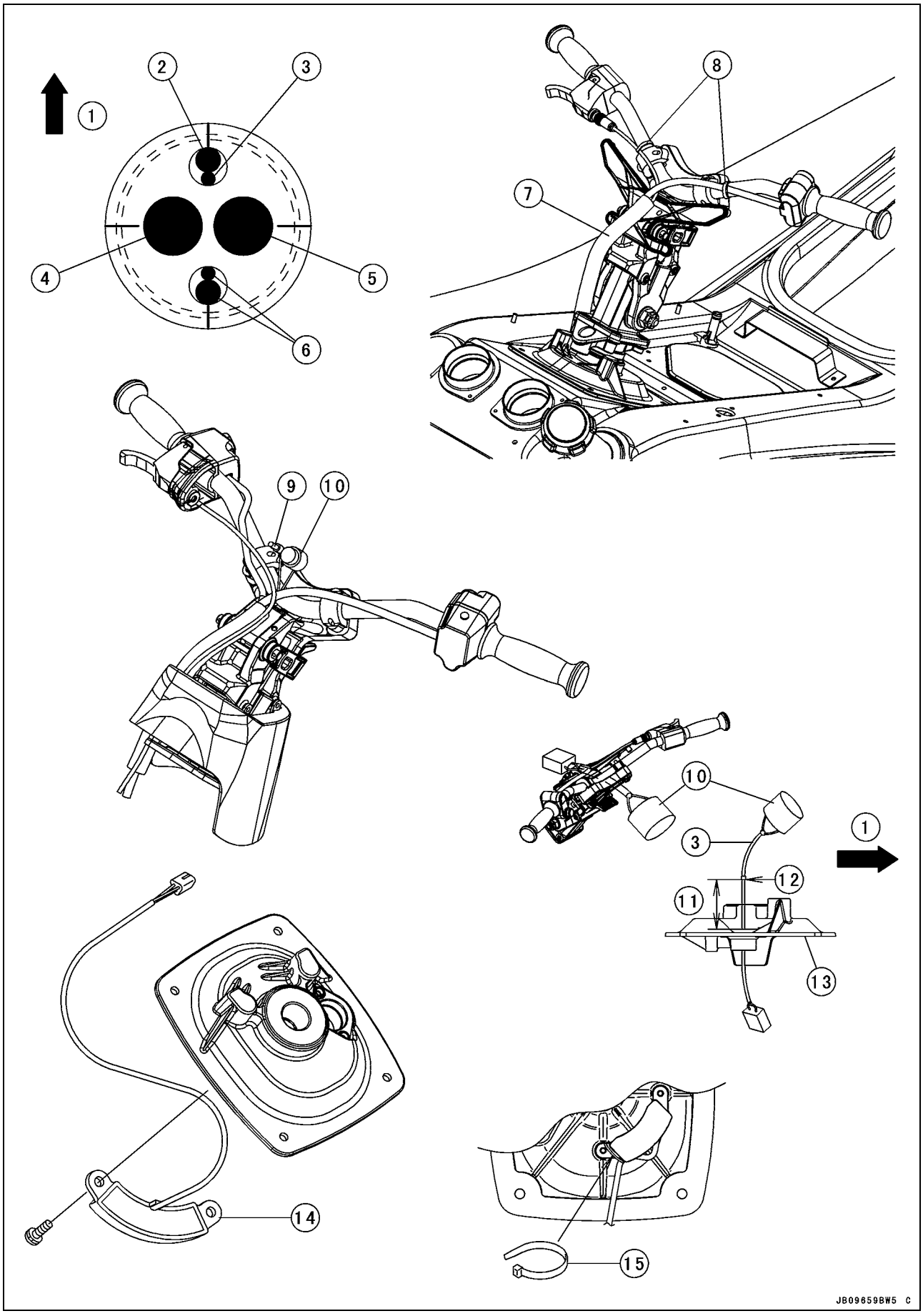
## Cable, Wire and Hose Routing



## Cable, Wire and Hose Routing

1. Starter Relay Connector
2. Starter Relay Cable
3. Run the starter relay cable and leads through the battery rearward.
4. Wrap the leads with the black tape.
5. Fuse Case
6. Starter Relay
7. Immobilizer/Kawasaki Diagnostic System Connector
8. Battery (–) Cable
9. Battery
10. Battery (+) Cable
11. Bow

## Cable, Wire and Hose Routing



## Cable, Wire and Hose Routing

1. Bow
2. Throttle Cable
3. Buzzer Lead
4. Meter Unit Leads
5. Fuel Vent Hose
6. Left Handlebar Switch Lead
7. Protective Tube
8. Bands
9. Air Temperature Sensor
10. Buzzer
11. 50 mm (1.97 in.)
12. White Tape
13. Steering Holder
14. Steering Position Sensor
15. Band

## Troubleshooting Guide

**NOTE**

○*Refer to the Fuel System (DFI) chapter for most of DFI troubleshooting guide.*

○*This is not an exhaustive list, giving every possible cause for each problem listed. It is meant simply as a rough guide to assist the troubleshooting for some of the more common difficulties.*

### Engine Doesn't Start, Starting Difficulty

**Starter motor not rotating**
- Starter motor trouble (brushes worn)
- Battery voltage low
- Starter relay not contacting or operating
- Start button not contacting
- Wiring open or shorted
- Ignition switch trouble
- Engine stop switch trouble
- Fuse blown
- Immobilizer system trouble

**Starter motor rotating but engine doesn't turn over**
- Reduction gear trouble
- Vehicle-down sensor (DFI) coming off

**Engine won't turn over**
- Valve seizure
- Valve lifter seizure
- Cylinder, piston seizure
- Crankshaft seizure
- Connecting rod small end seizure
- Connecting rod big end seizure
- Camshaft seizure

**No fuel flow**
- No fuel in tank
- Fuel tank air vent obstructed
- Fuel pump screen and/or fuel filter clogged
- Fuel injector trouble
- Fuel line clogged

**Engine flooded**
- Clean spark plug and adjust plug gap
- Starting technique faulty (When flooded, do not crank the engine with the throttle fully opened. This promotes engine flood because more fuel is supplied automatically by DFI.)

**No spark; spark weak**
- Ignition coil faulty
- Vehicle-down sensor (DFI) coming off
- Vehicle-down sensor trouble
- Ignition switch turned OFF and/or lanyard key not pushed under stop button
- Battery voltage low
- Spark plug dirty, broken, or gap maladjusted
- Ignition coil shorted or not in good contact
- Ignition coil trouble
- Spark plug incorrect
- Spark plug cap trouble
- Spark plug cap shorted or not in good contact
- IC igniter in ECU trouble
- Camshaft position sensor trouble
- Crankshaft sensor trouble
- Wiring shorted or open
- Fuse blown

**Fuel/air mixture incorrect**
- Air passage clogged
- Air box poorly sealed
- Fuel injector trouble
- Water or foreign matter in fuel
- Throttle sensor trouble
- Fuel pressure may be low
- Fuel pump trouble
- Intake air pressure sensor trouble
- Intake air temperature sensor trouble
- Water temperature sensor trouble
- Crankshaft sensor trouble

**Compression Low**
- Spark plug loose
- Cylinder head not sufficiently tightened down
- No valve clearance
- Cylinder, piston worn
- Piston ring bad (worn, weak, broken, or sticking)
- Piston ring/groove clearance excessive
- Cylinder head gasket damaged
- Cylinder head warped
- Valve spring broken or weak
- Valve not seating properly (valve bent, worn, or carbon accumulation on the seating surface)

### Poor Running at Low Speed

**Spark weak**
- Battery voltage low
- Spark plug dirty, broken, or maladjusted
- Ignition coil shorted or not in good contact
- Ignition coil trouble
- Spark plug incorrect
- Spark plug cap trouble
- Spark plug cap shorted or not in good contact
- IC igniter in ECU trouble
- Camshaft position sensor trouble
- Crankshaft sensor trouble

**Fuel/air mixture incorrect**
- Air passage clogged
- Air box poorly sealed
- Fuel tank air vent obstructed
- Fuel pump trouble
- Intake air duct loose
- Fuel pump screen and/or fuel filter clogged

## Troubleshooting Guide

Throttle body assy loose
Throttle body assy gasket damage
Fuel line clogged
Intake air pressure sensor trouble
Air temperature sensor trouble

**Engine stalls easily**
Fuel pump trouble
Fuel injector trouble
Throttle sensor trouble
Camshaft position sensor trouble
Fuel pressure too low or too high
Intake air pressure sensor trouble
Water temperature sensor trouble
Air temperature sensor trouble
Fuel line clogged
Crankshaft sensor trouble
Ignition coil trouble

**Compression low**
Spark plug loose
Cylinder head not sufficiently tightened down
No valve clearance
Cylinder, piston worn
Piston ring bad (worn, weak, broken, or sticking)
Piston ring/groove clearance excessive
Cylinder head warped
Cylinder head gasket damaged
Valve spring broken or weak
Valve not seating properly (valve bent, worn, or carbon accumulation on the seating surface)

**Hesitation**
Too low fuel pressure
Clogged fuel line
Fuel pump trouble
Fuel injector trouble
Air temperature sensor trouble
Throttle sensor trouble
Water temperature sensor trouble
Intake air pressure sensor trouble
Loose injector connectors
Crankshaft sensor trouble
Ignition coil trouble
Loose terminal of battery (–) lead or engine ground lead

**Poor acceleration**
Too low fuel pressure
Water or foreign matter in fuel
Clogged fuel filter or pump screen
Fuel pump trouble
Fuel injector trouble
Air temperature sensor trouble
Water temperature sensor trouble
Ignition coil trouble
Engine oil level to high
Spark plug dirty, broken or gap maladjusted

**Stumble**
Too low fuel pressure
Fuel injector trouble
Throttle sensor malfunction
Water temperature sensor trouble
Intake air pressure sensor trouble

**Surge**
Unstable fuel pressure
Fuel injector trouble
Water temperature sensor trouble

**Backfiring when deceleration**
Spark plug dirty, broken or gap maladjusted
Too low fuel pressure
Fuel pump trouble
Throttle sensor trouble
Air temperature sensor trouble
Water temperature sensor trouble
Intake air pressure sensor trouble

**After fire**
Crankshaft sensor trouble
Spark plug burned or gap maladjusted
Air temperature sensor trouble
Water temperature sensor trouble
Intake air pressure sensor trouble
Fuel injector trouble

**Run-on (dieseling)**
Ignition switch trouble
Engine stop switch trouble
Fuel injector trouble
Loose terminal of battery (–) lead or ECU ground lead
Carbon accumulating on valve seating surface
Engine overheating

**Other**
IC igniter in ECU trouble
Engine oil viscosity too high
Engine overheating
Intermittent any DFI fault and its recovery

### Poor Running or No Power at High Speed

**Firing incorrect**
Spark plug dirty, broken, or maladjusted
Ignition coil shorted or not in good contact
Ignition coil trouble
Spark plug incorrect
Spark plug cap trouble
Spark plug cap shorted not in good contact
Camshaft position sensor trouble
IC igniter in ECU trouble
Crankshaft sensor trouble

**Fuel/air mixture incorrect**
Air box poorly sealed
Air box O-ring damaged
Intake air duct loose
Water or foreign matter in fuel

Fuel to injector insufficient (DFI)
Fuel tank air vent obstructed
Fuel line clogged
Fuel pump trouble (DFI)
Injector clogged
Throttle body assy loose
Throttle body assy gasket damaged
Fuel line clogged
Fuel pump operates intermittently
Air temperature sensor trouble
Throttle sensor trouble
Intake air pressure sensor trouble

**Compression low**
Spark plug loose
Cylinder head not sufficiently tightened down
No valve clearance
Cylinder, piston worn
Piston ring bad (worn, weak, broken, or sticking)
Piston ring/groove clearance excessive
Cylinder head gasket damaged
Cylinder head warped
Valve spring broken or weak
Valve not seating properly (valve bent, worn, or carbon accumulation on the seating surface.)

**Knocking**
Carbon built up in combustion chamber
Fuel poor quality or incorrect
Spark plug incorrect
IC igniter in ECU trouble
Camshaft position sensor trouble
Crankshaft sensor trouble
Ignition coil trouble
Air temperature sensor trouble

**Miscellaneous**
Throttle valve won't fully open
Engine overheating
Engine oil level too high
Engine oil viscosity too high
Camshaft cam worn

## Overheating

**Firing incorrect**
Spark plug dirty, broken, or maladjusted
Spark plug incorrect
IC igniter in ECU trouble

**Fuel/air mixture incorrect**
Intake air duct loose
Air box poorly sealed
Air box O-ring damaged

**Compression high**
Carbon built up in combustion chamber

**Engine load faulty**
Engine oil level too high
Engine oil viscosity too high

**Lubrication inadequate**
Engine oil level too low
Engine oil poor quality or incorrect

**Oil cooler incorrect**
Oil cooler clogged

**Sensor incorrect**
Water temperature sensor broken

## Over Cooling

**Sensor incorrect**
Water temperature sensor broken

## Abnormal Engine Noise

**Knocking**
IC igniter in ECU trouble
Carbon built up in combustion chamber
Fuel poor quality or incorrect
Spark plug incorrect
Overheating

**Piston slap**
Cylinder/piston clearance excessive
Cylinder, piston worn
Connecting rod bent
Piston pin, piston pin hole worn

**Valve noise**
Valve clearance incorrect
Valve spring broken or weak
Camshaft bearing worn
Valve lifter worn

**Other noise**
Connecting rod small end clearance excessive
Connecting rod big end clearance excessive
Piston ring/groove clearance excessive
Piston ring worn, broken, or stuck
Piston ring groove worn
Piston seizure, damage
Cylinder head gasket leaking
Crankshaft runout excessive
Engine mount loose
Crankshaft bearing worn
Camshaft chain tensioner trouble
Camshaft chain, sprocket, guide worn
Alternator rotor loose

## Oil Pressure Warning Indicator Light Goes On

Oil pump damaged
Oil screen clogged
Oil filter clogged
Engine oil level too low
Engine oil viscosity too low
Camshaft bearing worn
Crankshaft bearing worn
Oil pressure switch damaged

Wiring faulty
O-ring at the oil passage in the crankcase damaged

## Battery Trouble

**Battery discharged**
Charge insufficient
Battery faulty (too low terminal voltage)
Battery cable making poor contact
Alternator trouble
Wiring faulty
Regulator/rectifier trouble

**Battery overcharged**
Alternator trouble
Regulator/rectifier trouble
Battery faulty

## Poor Performance through Engine Runs Properly

**Jet pump**
Intake area obstructed
Impeller or pump case damaged
Excessive clearance between impeller and pump case

## Poor Steering Control (Since faulty steering is dangerous, this problem should be examined by an authorized Jet Ski dealer)

**Handlebar hard to turn**
Steering maladjusted
Bushing damaged or cracked
Steering shaft bent
No lubricant on steering pivot
Steering cable damaged or improperly routed

## Engine Activates Slow Down Mode

**Cooling water temperature gets high**
Weeds or debris in jet pump
Cooling water line clogged

**Low oil pressure**
Low oil level
Improper engine oil quality

**Water temperature sensors malfunction, wiring open or short**

**Vehicle-down sensor malfunction, wiring open or short**

**Oil temperature sensor gets high**
Low oil level
Oil pump malfunction
Oil pressure relief valve malfunction
Weeds or debris in jet pump
Cooling water line clogged

**Oil temperature sensor malfunction, wiring open or short**

## MODEL APPLICATION

| Year | Model | Beginning Hull No. |
|---|---|---|
| 2012 | JT1500KC | US-KAW50001□112<br>US-KAW59001□112 |

□:This digit in the hull number changes from one machine to another.

Kawasaki
KAWASAKI HEAVY INDUSTRIES, LTD.
Motorcycle & Engine Company

**Part No.99924-1451-01**

Printed in Japan